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Making Transformer Castings

Ingenious and Adequate Machine and Pattern Equipment Together with an Intelligent Selection of the Proper Grade of Sand Has Lifted These Castings Out of the Hazardous Class

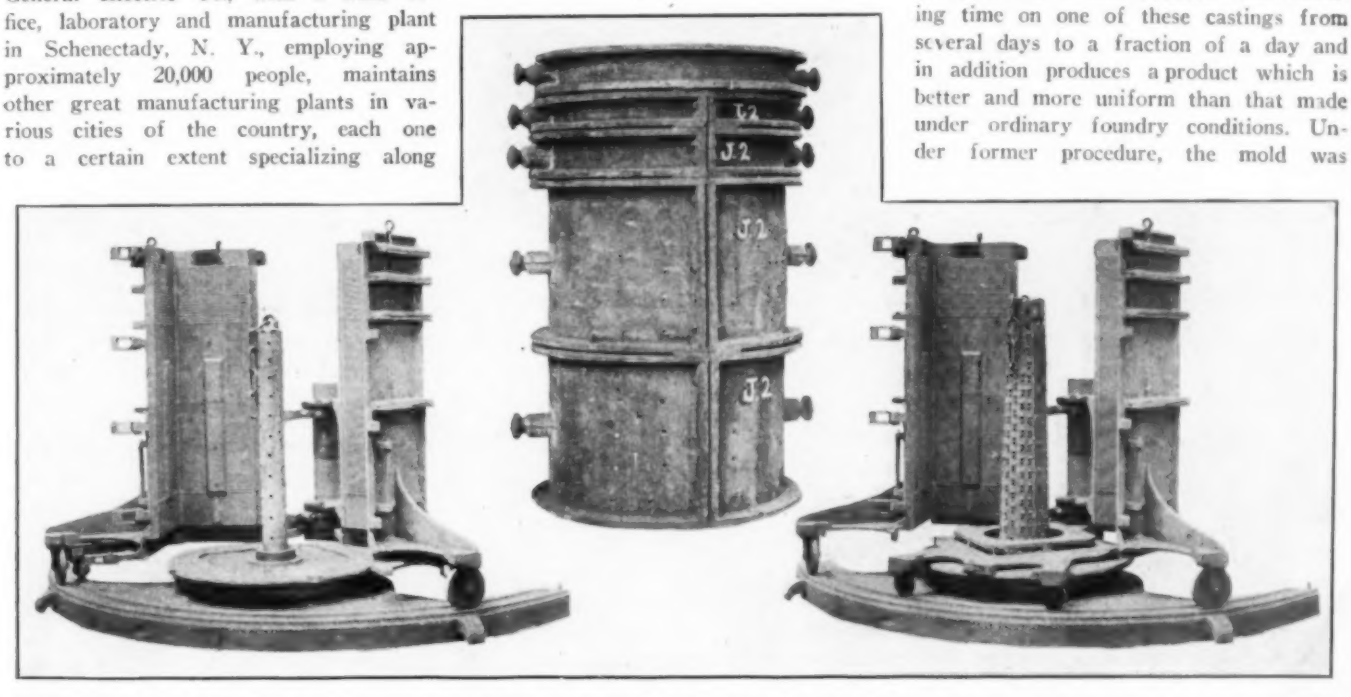
BY PAT DWYER

POSSIBLY at some future time when the permanent mold has been developed to a point where it is a commercial success, the various phases of casting metals may be as susceptible to rapid and standardized production as the processes that for many years have been in use in machine shops. However, so many variables enter even in foundries producing a standard line of castings that only in a comparatively small number do the methods approach those practiced in the machine industry. The General Electric Co., with a head office, laboratory and manufacturing plant in Schenectady, N. Y., employing approximately 20,000 people, maintains other great manufacturing plants in various cities of the country, each one to a certain extent specializing along definite lines. For example, transformer boxes comprise the greater part of the output from the foundry of the Pittsfield, Mass., plant.

Oil is placed in transformer boxes when in use, therefore, the castings must be sound, homogeneous and free from leaks. They are made in many sizes, plain and corrugated, but are turned out in such quantities that it has been found advantageous to use standardized pattern andother equipment.

At one time all the corrugated boxes were made of cast iron, but in recent years the larger sizes have been formed of corrugated steel sheets with a cast-iron top and bottom. The box frame is set into an open sand mold and when the iron is poured into the mold it fuses to the end of the sheet and anchors it securely in place. However, boxes up to 25 inches square, 72 inches high and weighing 2000 pounds, similar to that shown in Fig. 6, still are made of cast iron.

The pattern equipment shown in Figs. 1, 3, 4 and 6 has reduced the molding time on one of these castings from several days to a fraction of a day and in addition produces a product which is better and more uniform than that made under ordinary foundry conditions. Under former procedure, the mold was



FIGS. 1 AND 3—GENERAL AND DETAILED FEATURES OF HINGED COREBOX FOR REGULATOR TANK 25 INCHES SQUARE, 72 INCHES HIGH. FIG. 2—STYLE OF FLASK EMPLOYED FOR SAME CASTING

rammed by hand and a row of nails was bedded in the sand between the grooves at every course of ramming. The process was slow and even in the hands of a careful man, soft places occasionally developed on the face of the mold and remained undetected until subjected to the pressure of the iron. Swollen areas on the surface of the casting resulted and detracted both from the usefulness and appearance of the casting.

In the method now in vogue a special dry sand facing has been evolved for filling the spaces between the ribs. This facing requires no reinforcement such as nails or rods. Consequently, ramming the mold is simplified and the danger from soft spots practically is eliminated. The method by which the pattern is removed from the mold is responsible in great measure for the results achieved in this foundry.

The device shown in Fig. 6 is used in a pit below the floor level in such a manner that the stripping plate remains flush with the floor of the foundry. The pattern is attached to a rigid foundation plate which is moved up and down on four threaded rods or screws at each corner. Power for driving the screws is furnished by a small motor attached to the base of the machine and is transmitted to the four simultaneously by an ingenious arrangement of worm gears on two parallel shafts. The pattern is drawn steadily, evenly and what is more important, absolutely accurately and as a result the sand forming the spaces between the ribs remains intact and undisturbed. Another advantage of this device is that the pattern may be locked at any point which may be required to make boxes of any desired length.

Special flasks, similar to that shown in Fig. 2 are employed for making these castings. The two lower sections are each 30 inches in height and the two upper sections 5 and 7 inches respectively. One or both of the upper sections may be omitted when shorter castings are being made.

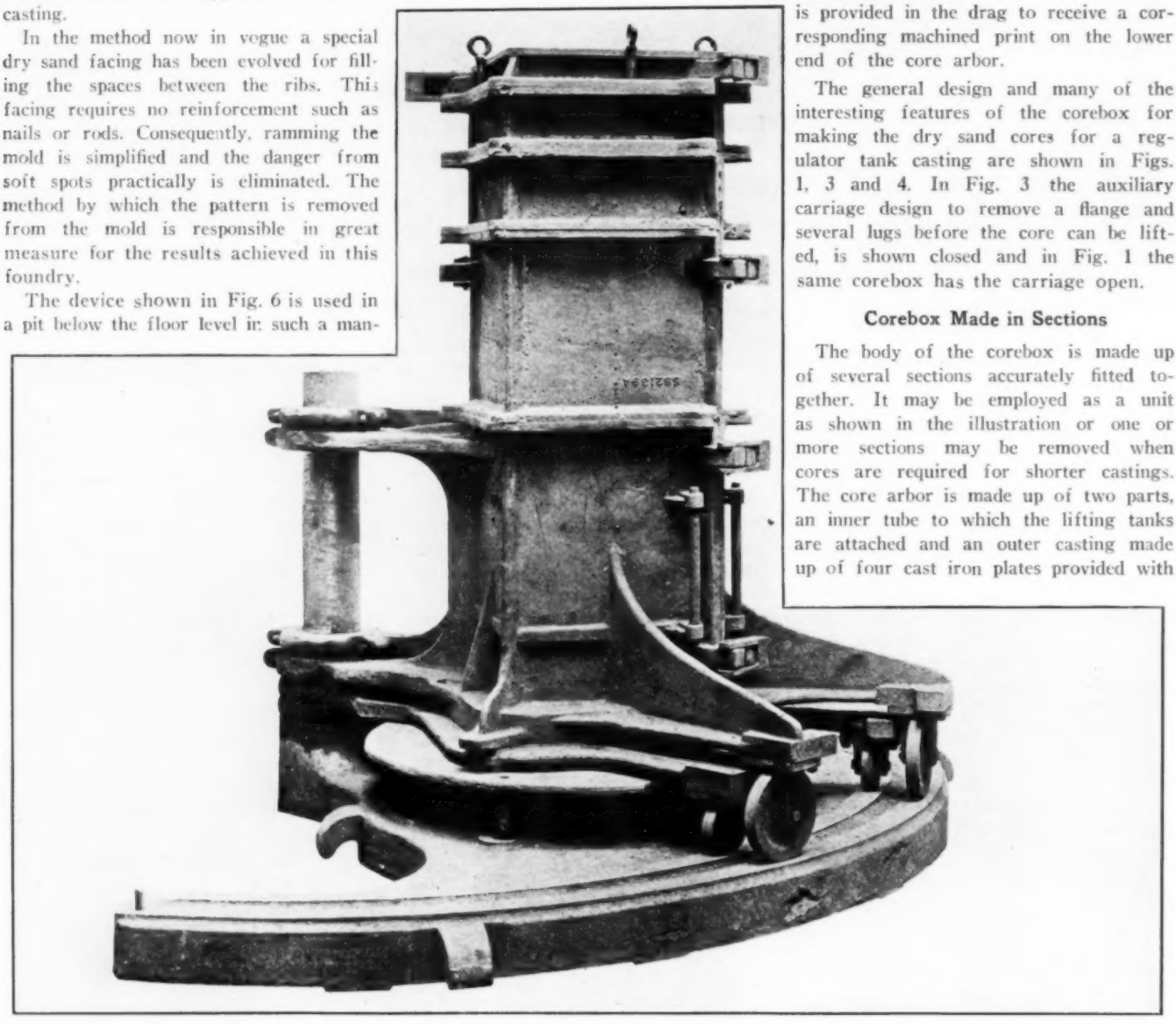


FIG. 4—EXTERIOR VIEW OF REGULATOR TANK COREBOX SHOWING DETAIL OF HINGES AT BACK AND CLAMPS AND ROLLERS IN FRONT

The flasks are provided with planing strips on all joints and thus while the parts are brought into accurate and intimate contact at several points on adjoining surfaces, the remainder of the joint is left open for the escape of steam in drying the molds and for the escape of gas during pouring. The flask sections also are provided with small cored holes that serve the same purpose over the entire surface.

The foregoing description applies to the cheek part of the mold. The cope and drag are one-part flasks and are rammed independently on suitable pattern plates. The various parts of the flasks are interchangeable and guide pins are located in such a manner that it is impossible to assemble a complete mold in any except the proper position. A machined seat is provided in the drag to receive a corresponding machined print on the lower end of the core arbor.

The general design and many of the interesting features of the corebox for making the dry sand cores for a regulator tank casting are shown in Figs. 1, 3 and 4. In Fig. 3 the auxiliary carriage design to remove a flange and several lugs before the core can be lifted, is shown closed and in Fig. 1 the same corebox has the carriage open.

Corebox Made in Sections

The body of the corebox is made up of several sections accurately fitted together. It may be employed as a unit as shown in the illustration or one or more sections may be removed when cores are required for shorter castings. The core arbor is made up of two parts, an inner tube to which the lifting tanks are attached and an outer casting made up of four cast iron plates provided with short dabbers and vent holes. The inner tube is lowered into a seat in the bottom of the corebox and the four pieces of casing are assembled around it. They are held in place by two strands of wire. One set of inner tubes serves for all the castings, but the casings are provided in several lengths to correspond with the various sizes of tanks. The corebox is split longitudinally and vertically and arranged in such a manner that the two halves swing apart laterally after the core is rammed and ready

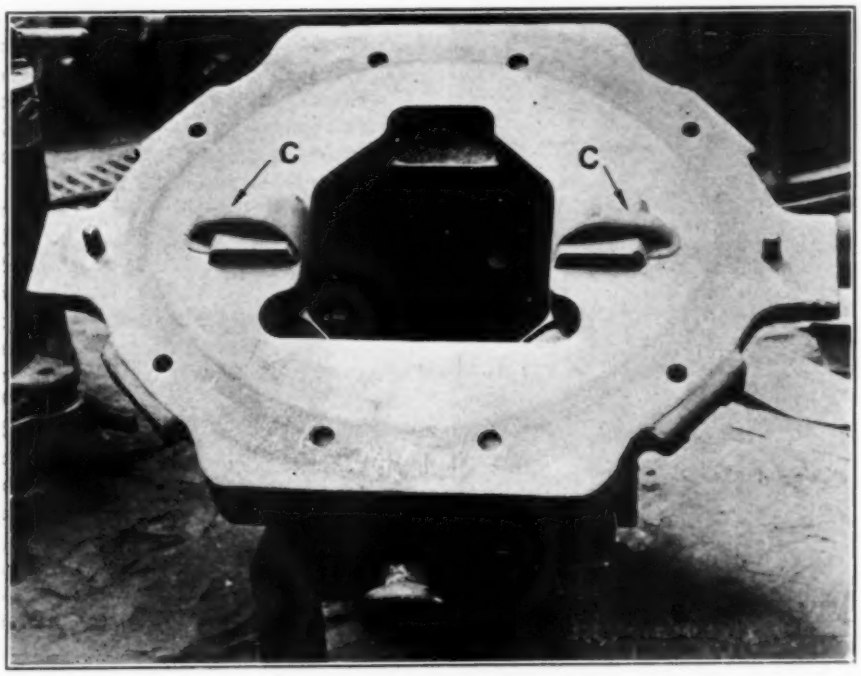


FIG. 5—THE DRAG AND CORE ARE FORMED AT ONE TIME ON A COMBINED COREBOX AND PATTERN PLATE

for removal. It is mounted on a cast-iron base provided with an upright post at the back which serves as a bearing post for the hinged bearings projecting from the back edges of each half of the corebox. The front of each half is supported on a long bracket attached to a wheel bearing which travels back and forth on an arc of a circle machined on the upper face of the foundation plate.

All the parts are heavy and rigid to prevent the slightest distortion and also to insure long life under severe operating conditions. Extreme accuracy also is essential, because the cores are destined to form the interior of castings with a uniform overall thickness of not more than 3/8 inch. Four links are provided on the front edge of the corebox to hold the halves together and to prevent any springing during ramming. The hinges serve to hold the lower halves of the corebox together at the back, but two links similar to those in front are provided at the back to hold the upper edges of the two halves in close contact.

Green Sand Molds Used

One bay of the Pittsfield foundry is devoted to the production of plain types of transformer boxes in various sizes, but all conforming to the general appearance of the pattern shown in Fig. 10. Floors similar to that shown in Fig. 7 extend on both sides from a central gangway to the wall. These castings are made on from 20 to 27 floors, with two men to a floor and the daily amount of iron required to pour the work ranges between 18 and 20 tons. The number of molds to a floor varies from 6 to 36, depending on the size. The molds, both inside and out, are made entirely in green sand.

A fairly coarse grade of Albany sand is employed in making the molds. It is tempered and mixed mechanically and carefully maintained at a uniform dampness and density. The sand is open and porous and, therefore, although the men are instructed to ram the molds fairly hard, no difficulty is experienced from blowholes or scabs. This despite the fact that a vent wire is not employed and no vent holes are provided in the sides of the flasks.

The foundry occupies a space on the side of a hill and a basement extends under the entire foundry floor. This basement is utilized in many ways, but the only object in mentioning it now is because it serves to some extent in the sand handling and reconditioning process. After the castings are poured, the flasks are shaken out over a grating in the center of each floor. The sand falls to the basement where it is again prepared for use and then sent up in bucket elevators, one of which serves each floor, and discharges through a spout on to a pile at the back of the floor. This latter feature is illustrated in the background of Fig. 7. Each floor is served by a light, hand-controlled electric hoist and, therefore, it is quite feasible to ram the mold and core close to the sand pile at the back of the floor and afterward lift them to any desired section of the floor where they must be assembled and poured.

On account of the limited clearance between the core and the wall of the mold it is essential that the cheek be lowered perfectly plumb and in line with the vertical faces of the core. The same applies to lifting the corebox off the high green sand core. The variable factor in both these operations has been removed by providing cranes with a slight upward camber toward the center of the bridge. The crane is provided with an electric hoist, but the carriage is pulled back and forth across the bay by hand, and the bridge is moved in the same manner. A load may be held at any point on the bridge traverse, but to insure accuracy the molds are assembled in two straight rows, one row under each end of the bridge. The bridge is slightly cambered from the center to either end to facilitate pulling the load. When the operator pulls the carriage up against the stop at either end and then lowers the combined drag and core on the floor he knows that when later he pulls the cheek up against

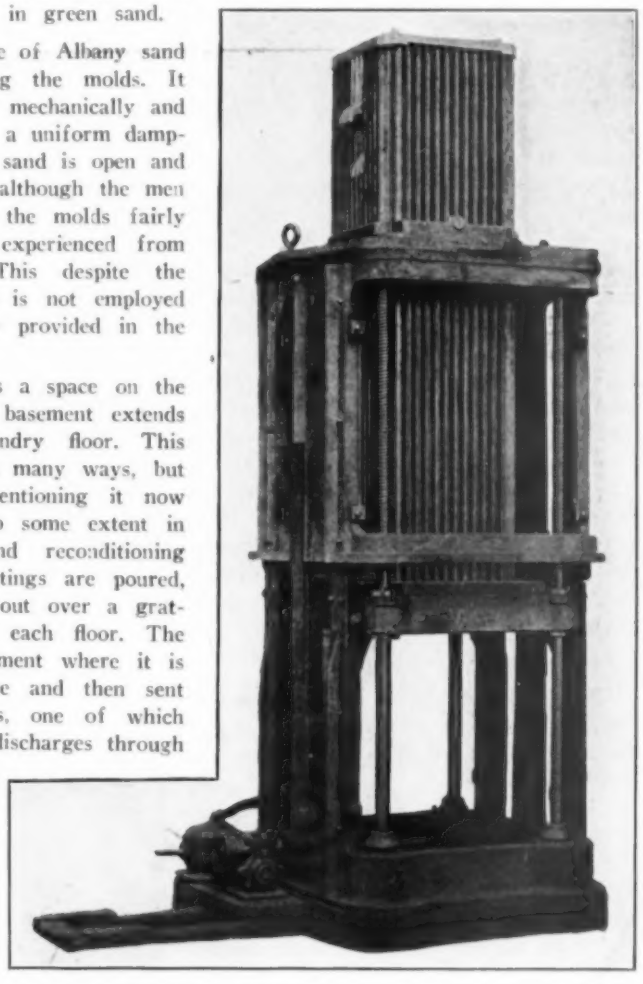


FIG. 6—THE PATTERN FOR THE REGULATOR TANK IS DRAWN DOWN THROUGH A STRIPPING PLATE—FOUR LONG SCREWS WORKING SIMULTANEOUSLY MOVE THE PATTERN UP AND DOWN

FIG. 7—ONE OF THE TRANSFORMER FLOORS SHOWING PART OF THE GRATING IN THE FLOOR AND ALSO THE SAND CHUTES AT THE BACK. TWO MEN ARE USED ON EACH FLOOR

the same stop it will descend to its proper position.

Substantial iron coreboxes and patterns after the general style of those shown in Figs. 5 and 10 are provided for making the molds. A combined drag and core as it appears when set down on the floor is shown in Fig. 9. The corebox as it appears suspended from the crane after it is lifted off the core is shown in the extreme background Fig. 7.

The problem of insuring a clean vertical lift from the green sand core has been solved by providing a ring screwed into the center of the corebox bottom on the outside. The ring is adjusted in such a manner that when the box is suspended from the crane it hangs perfectly plumb and balanced and, therefore, when it is lifted the core is not disturbed.

Making the Mold

No special attempt is made to level the corebox before it is filled with sand. It is placed on the floor in an approximately level position, face up, as shown in Fig. 5. In the illustration the box is turned partly on one side to show the interior. Small dry sand cores are placed in the various pockets before green sand is shoveled in. These cores serve as reinforcing tips on the small green sand mounds shown at *AA* Fig. 9.

The lugs shown on the inside of the corebox in Fig. 5 are movable and controlled by a lever on the outside. They are left in place until the box is rolled over and then pulled back to permit the box to be lifted off the core. The sand on the inside of the corebox is rammed fairly soft in the bottom of the corebox and a little harder around the upper part to prevent it from straining when the mold is filled with iron. On the smaller boxes, the drag is placed on the corebox and both are rammed at the same time, but on the larger boxes the corebox is filled and rammed first then the drag is set on, filled with sand and rammed. The plate is provided with two guide pins corresponding to the two pin holes in the drag and cheek. These pins locate the drag accurately in relation to the core and insure that when the cheek is closed later it will provide an even wall thickness for the reception of the iron.

Two trunnions, one on either side of the corebox, provide a ready means of rolling the combined corebox and drag. The trunnions are placed a little below the center of gravity on the combined load and, therefore, the instant the load is lifted clear of the floor it swings over by itself. It is lowered to the floor, the slings are removed and then the crane hook is attached to the ring

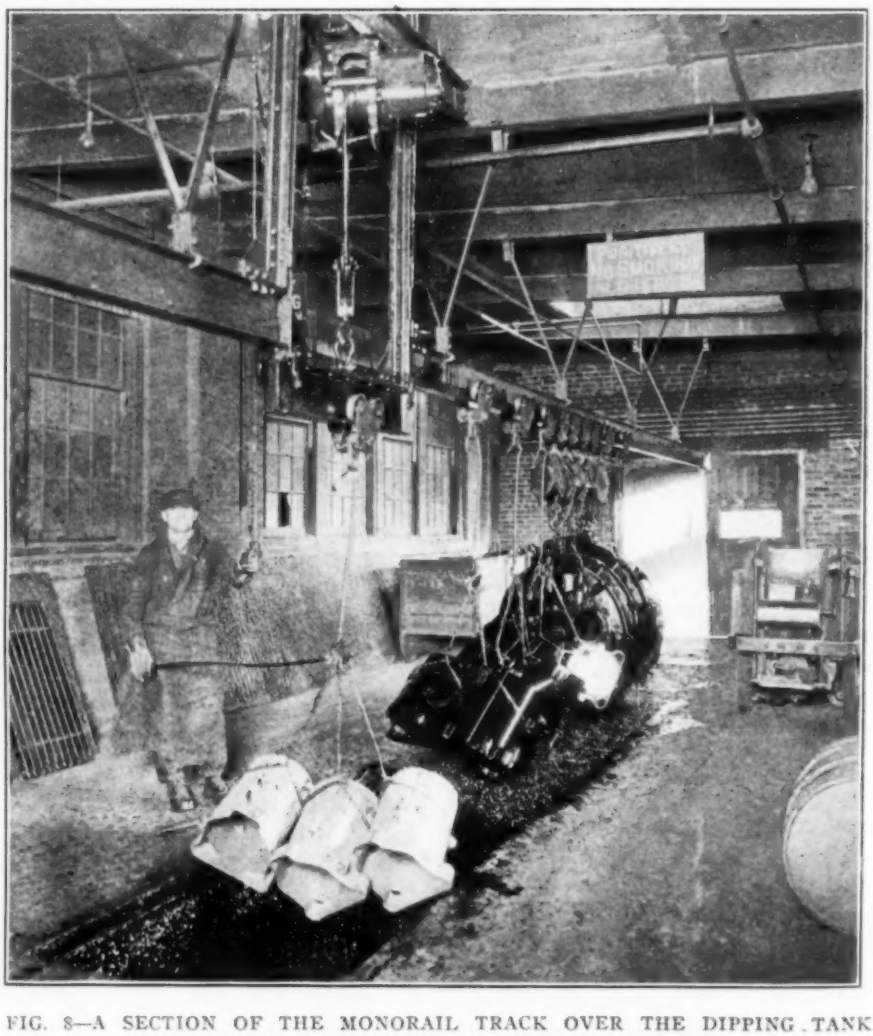


FIG. 8—A SECTION OF THE MONORAIL TRACK OVER THE DIPPING TANK SLIDES UP AND DOWN IN SUITABLE GUIDES

fastened to the bottom of the corebox. The load is lifted clear of the floor, transported to its appointed place and lowered slowly. Just before the bottom plate touches the floor, wood wedges are pushed under at two or three points thus automatically leveling the assembled device. The clamps holding the corebox and drag together are knocked off and then when the power once more is applied to the crane, the corebox is lifted straight and true leaving the drag and core in the position illustrated in Fig. 9.

The cheek is formed on the pattern and plate shown in Fig. 10. The flask is guided into place by two loose pins projecting from pin holes in the flask lugs corresponding to pin holes in the pattern plate. These pins are removed after the cheek is rammed and replaced by two long guide pins placed temporarily in the drag to guide the cheek down into place over the high green sand core.

Runner sticks are located in place before the cheek flask is filled with sand by the two small holes shown at *B B*, Fig. 10. By referring to Fig. 5 it will be noted that the location of the runner sticks on the cheek plate *B B* Fig. 10 correspond to the outer ends of the permanent horn gates *C C* Fig. 5. The horn gate effect by which the iron is directed in an upward direction into the mold, is secured by a flat core placed in the depression formed by the core print shown at *C C*, Fig. 5. The core also serves to maintain the original size of the gate opening in a more satisfactory manner than green sand, which frequently under similar conditions wears away under the erosive influence of the flowing stream of iron.

The lugs shown at *D*, Fig. 10, are designed to hold certain pocket cores in place until the flask is rammed full of sand. They then are drawn into the pattern by an ingenious toggle jointed lever which pulls all four lugs at one movement. The pattern is a shell with a removable section on the top surface. This cover remains in place and prevents any sand from entering during the process of ramming the cheek and cope. After the cope is lifted off, the cover is removed from the top of the pattern to allow the operator to pull in the core supporting lugs.

Castings Are Dipped

The dipping tank is in the basement where the castings are coated with a pitch covering as shown in Fig. 8. It is served by a monorail hoist which extends into an extensive cleaning and chipping room under the main floor of the foundry. After the castings are dipped they are allowed to drain for a time and then stacked on the adjacent platform for shipment. The shipping platform is built level with the floor of the railroad cars which are spotted on a siding adjoining the foundry building.

As a result of substituting mechanical methods, it is claimed that output and quality of transformer box castings is greatly in excess of that obtaining when castings were made by skilled molders under the ordinary methods practiced in former days. Hazardous features in connection with the production of these peculiar castings have been eliminated to such an extent that the work now is done by unskilled labor.

The defective casting loss is extremely low and the output of 6000 pounds of castings for each pair of men compares favorably with the output on other classes of castings that lend themselves more readily to large tonnage records.

Cupola practice in the Pittsfield foundry presents no unusual features. The iron is melted clean and unusually hot and is distributed to the various floors by a monorail system that extends from one end of the building to the other. The ladles are dropped at each floor and then picked up and poured by the individual cranes serving each floor during the day. On account of the comparatively thin section of the castings, iron is charged to produce castings of the following analysis: Silicon, 2.75 per cent; sulphur, 0.10 per cent; manganese, 0.45 per cent; phosphorus, 0.55 per cent.

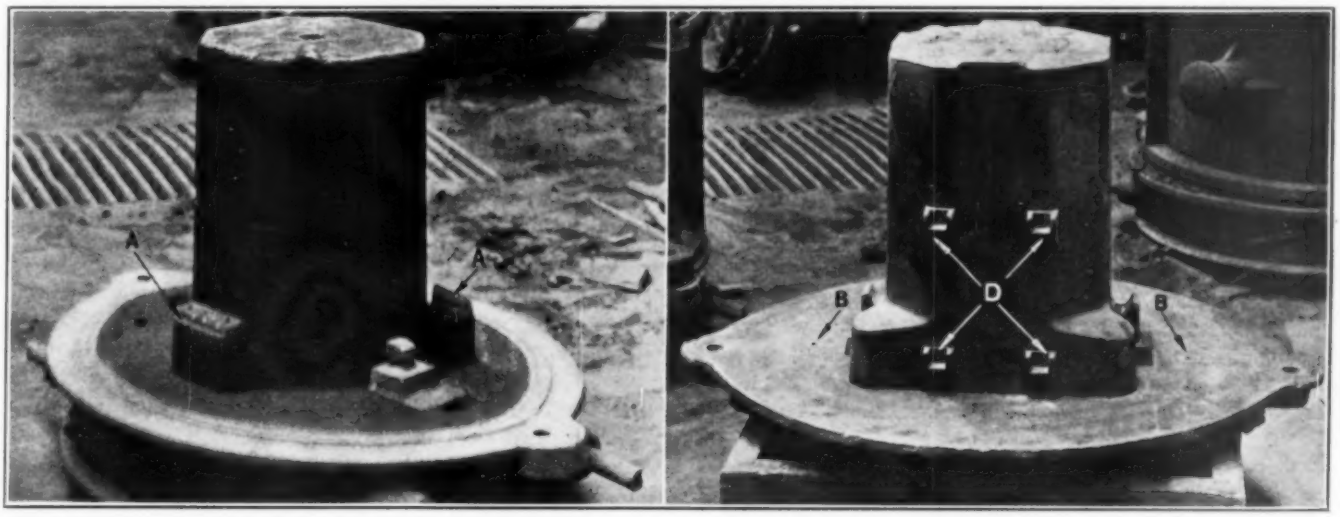


FIG. 9—SMALL DRY SAND CORES ARE RAMMED UP IN THE PATTERN TO REINFORCE THE GREEN SAND POCKETS *AA*
FIG. 10—THE LUGS ON THE SIDE OF THE PATTERN SERVE TO HOLD LUG CORES DEFINITELY IN PLACE —THE PATTERN LUGS ARE MOVABLE AND ARE DRAWN INTO THE PATTERN AFTER THEY HAVE SERVED THEIR PURPOSE

Organizes New Firm

The Metallurgical Service Co., 405 Mercantile Library building, Cincinnati, has just been organized by N. M. Salkover, who since 1922 until his resignation Jan. 1, has been metallurgist for the R. K. LeBlond Machine Tool Co., Cincinnati. The purpose of the new organization is to sell a complete line of metallurgical equipment and supplies in the Cincinnati district. In addition to its sales work, the company will give engineering service upon its products. Mr. Salkover is a graduate of the University of Cincinnati.

The Advance-Rumely Co., La Porte, Ind., has taken over the business of the Aultman & Taylor Machinery Co. at Mansfield, O. The Aultman & Taylor line of machinery is to be continued, but will be distributed by the Advance-Rumely organization.

Points Need for Sand Test

Experienced Foundryman Suggests Adoption of Simple Vibratory Test for Determining Relation of Silica and Bond Contents and Influence Upon Casting Losses

BY EUGENE W. SMITH

GOOD equipment, good metal and good sand properly cared for prove profitable investments in any class of foundry work. The latter probably is the most neglected and carelessly handled factor in foundry practice.

In the past we have used the old method of *squeeze* and *feel* to determine sand conditions. In some foundries little attention is paid to the amount of new sand distributed, whether 5000 pounds or 25,000 pounds, and often new sand is distributed whether needed or not, until trouble occurs from blows, cold-shuts, etc. Again, little new sand is provided until the reverse condition, *weak* sand, causes losses, crushes, scabs, cuts, rough finish, or drop-cuts.

The value of a perfectly good molding sand may be affectd by abuse in many ways, a few of which follow:

New sand stored in the open loses its natural bond, shortening its life and weakening the sand.

Sand brought to the foundry, frozen or wet, and dried by the use of waste metal is weakened.

Sand which is air-dried for any length of time, whether new or old, loses its bond quality, and if used before the *temper* has been restored, is weak.

Weak sand requires more water and this causes blows and slaggy castings, and in the case of light work hardens the metal.

Chemical Composition Not Important

All molding sands contain widely varying compositions of silica and clay and take on the characteristics of the rock from which they come. Many other elements may be present, but have no essential value for molding purposes. The man in the foundry is not necessarily interested in the chemical composition of the sand. However, he is vitally interested in its physical qualities. He must have a sand which will give him the desired finish suited to the class of castings he is to produce. In making this selection he must be guided by grainsize.

Permeability, the property which permits the escape of gases generated in the mold, is governed by the grain size, together with the fineness and quantity of the bonding elements, which fill between these grains. Excess bond destroys permeability.

The silica as separable by water, in a great many of our new sands, is divided into two parts. This finer or upper layer will also destroy the permeability of the sand, if in excess of 15 per cent.

Recommends Vibratory Test

To measure the proportion of bond and silica, as separated by water, but not the total silica as determined by chemical analysis; to examine the grain and determine its probable source; and to assure that the general texture of the sand is suitable for the class of castings required, the vibratory test is offered.

The vibratory test will be found a dependable guide for increasing or decreasing at will, the bond or silica in foundry sand which is in use. It affords a means for studying the physical qualities of new sands. Further, it affords a means of comparison between all interested in the production of castings of every grade.

The equipment required for the vibratory test includes six bottles, a vibrator and a 3-inch rule, divided in tenths.

First tabulate the daily castings losses and assumed causes. Separate all castings which can by any possibility be arributed to the sand or its manipulation. When in doubt as to the cause of loss, attribute it to the sand, as fully 50 per cent of casting losses are due to sand conditions, directly or indirectly, particularly if the equipment and the metal are known to be in good condition. Then determine, if possible, whether the greater part of this loss is due to sand which is too weak or sand which is too strong. Ascertain how much new sand has been added to the heaps each day, and if several grades are used, how much of each. Also determine in what manner it has been introduced—in large quantities, irregularly, or small quantities at regular intervals.

After all new sand of the day has been added, take a sample from a point which will fairly represent the sand of the day. About 3:00 p. m. fill a bottle not more than one-quarter full of sand. Then fill the remainder of the bottle with clear water. Shake thoroughly until the grains are washed. Vibrate about three minutes on any form of vibrator. Put the sample in a rack to remain until starting time next day. Measure the sample and label the bond and silica, showing figures for each.

The foreman or assistant then determines whether to add or decrease the amount of new sand for the coming day. The clerk also should keep a record of these figures each day, preferably on a sheet, showing the curve and its relation to the losses each day.

A convenient method is to obtain a cross ruled sheet, marking *dates* across top margin, *percentage* bottom to top on left hand margin, *losses* left to right across bottom margin.

The proper proportions must be determined by the operator himself and suited to the conditions under which he is required to work and the class of castings he is to produce. The tests necessarily must be run for several weeks before he will ascertain that small quantities of new sand added or left out will affect the curve mentioned. Then he must determine at what point he gets the best results.

This point may be indicated on the sheet by a dotted red line across the sheet at the point he wishes to maintain. A foundry may be divided into sections where different grades of castings are produced, and an entirely different figure determined for each.

Silica and Bond Curves Desirable

It is desirable that the bond curve be made in one color and silica curve in another ink across the sheet. It is not essential that both be kept, but having both, changes are much more noticeable.

Having arrived at the proportion of bond which the work requires, to give the best results—that point should be kept in mind at all times. Prac-

Abstracted from a paper presented by the author at a recent meeting of the Detroit Foundrymen's association. Mr. Smith is connected with the Crane Co., Chicago.

tice has shown that a variation of two per cent above or below this point will never cause any noticeable change in losses.

Increasing the bond 6 per cent will show a serious increase in losses through *blows*. Likewise 6 per cent below the proper point will cause *weak* sand, if maintained, with increased losses by strain, drop cuts, runouts, etc. Avoid radical changes in amounts of new sand used.

The following can be considered as approximating the proper figure for a good molding sand, but methods of pressing or ramming, also amount of core sand droppings in heaps or system must be considered. The estimated ratios follow:

	Bond Per cent of total	Silica Per cent of total
For light work (under 20 lbs.).....	30	70
For medium work (20 to 30 lbs.).....	50	50
For heavy work (60 to 300 lbs.).....	25	65

At first a discrepancy will be apparent in these figures, but it must be kept in mind that light work naturally will require a finer grain sand. The finer the sand, the less *bond* is required and in many cases the bond figure for light work will be too strong.

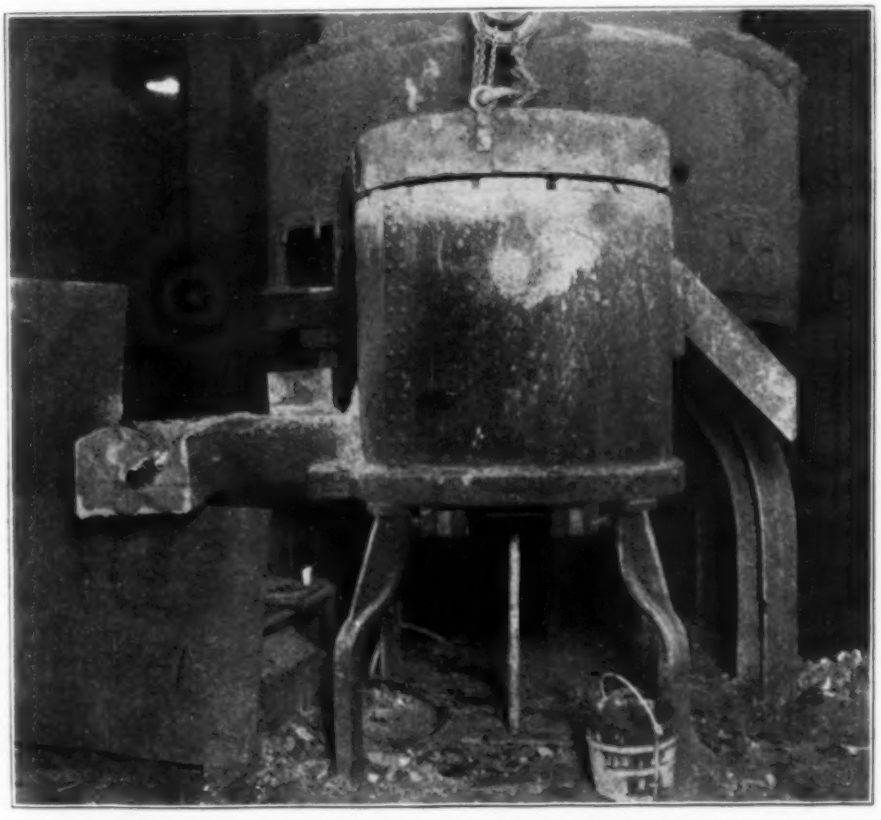
Again, the heavy work will naturally require a heavy grain sand and most likely a higher bond figure will be required, but the percentages are given to avoid excess bond filling between the grains and destroying permeability.

When it becomes commonly understood and properly applied, I believe the vibratory test will provide a means for comparing bond and silica contents of sands. The test applied by the sand producer and by the foundryman upon the receipt of his sand will serve to avoid many little differences which now occur.

Reservoir Takes Place of Mixing Ladle

BY H. R. SIMONDS

AN ADAPTATION of a cupola accessory quite prevalent in European foundries recently was installed in the gray iron foundry of the Chapman Valve Co., Indian Orchard, Mass. This innovation, shown in the accompanying illustration, consists of a fore-hearth or reservoir with a capacity of approximately 2 tons. The usual American practice is to provide a mixing ladle, temporary or permanent, in front of the spout, tap into it and fill the other ladles from it. In this instance it was felt that a covered reservoir would answer the purpose better, it would serve as a mixing chamber and retain the heat in the molten iron to a greater degree than an open ladle. Two cupolas are provided for melting the iron, one 96 and the other 90-inch shell lined down respectively to 78 and 72 inches inside diameter. Under present operating conditions the smaller cupola melts approximately 65 tons between 1:30 p. m. and 5 p. m., and therefore only one fore-hearth has been installed. In the event that the larger cupola is pressed into service it is the intention to provide it with a similar reservoir.



THE CUPOLA IS ALLOWED TO RUN INTO THE RESERVOIR IN A CONSTANT STREAM—THE RESERVOIR IS TAPPED TO FILL THE LADLES

The device was built and installed by the company's own workmen. It simply is a 4-foot, brick-lined shell mounted on a base plate supported by four legs, equipped with a drop bottom similar to a cupola and with a detachable cover, lifted on and off by a chain block. The cupola never is stopped after it starts melting. A constant stream is allowed to flow into the reservoir and the reservoir is tapped and stopped to accommodate the ladles employed to convey the metal to the molds. A semisteel mixture is employed and the mixing chamber insures a hot, clean, homogeneous metal. On account of the fore-hearth taking up the space formerly occupied by the spout it was necessary to attach the new spout to the side to bring the ladle under the monorail.

Changes Connection to Refractory Lines

Drew M. Thorpe, who for the past year has been district sales manager at Pittsburgh for the United States Refractories Corp., Mt. Union, Pa., has resigned to become Buffalo district sales manager for the General Refractories Co., Philadelphia, succeeding George A. Forbes. Prior to his affiliation with the United States Refractories Corp., Mr. Thorpe had been identified for approximately five years with E. J. Lavino & Co., Philadelphia, the latter part of that period as Pittsburgh sales representative on chrome and magnesite brick and ores.

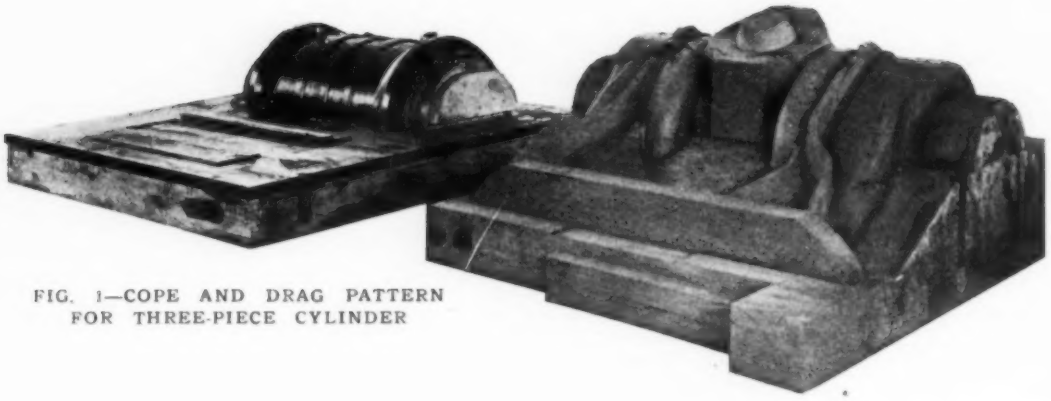


FIG. 1—COPE AND DRAG PATTERN FOR THREE-PIECE CYLINDER

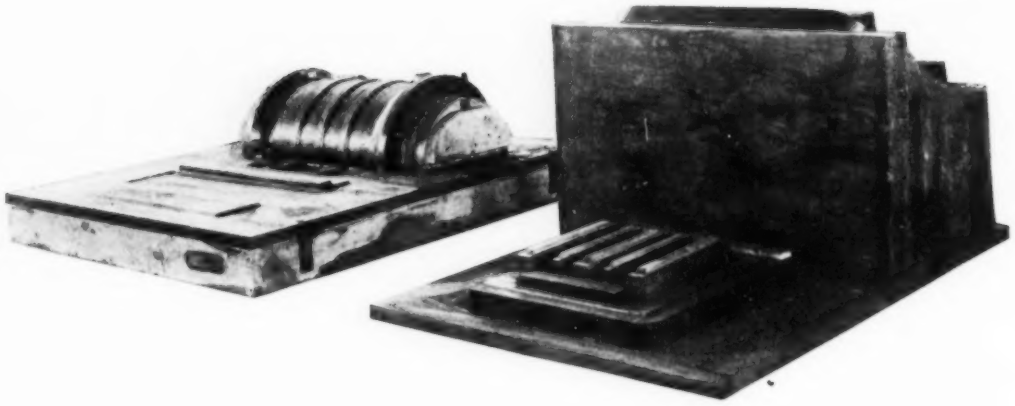


FIG. 2—COPE AND DRAG PATTERN FOR SLIDE VALVE CYLINDER

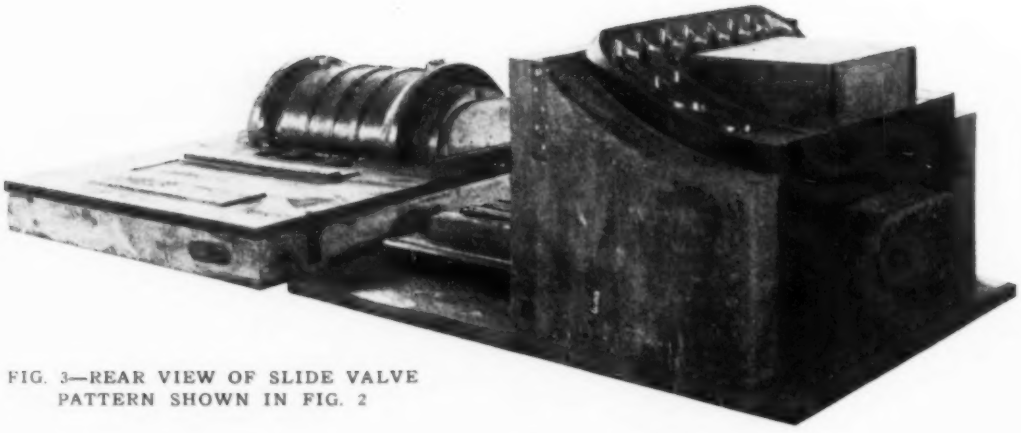
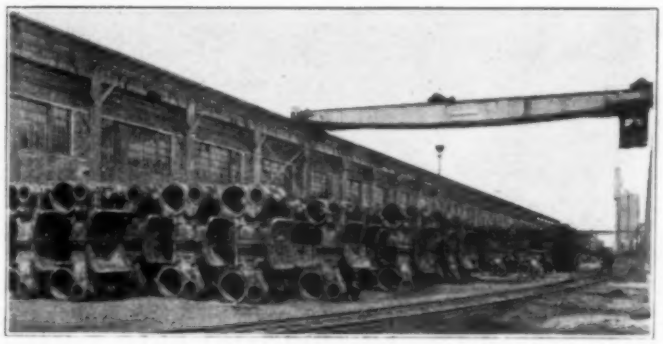


FIG. 3—REAR VIEW OF SLIDE VALVE PATTERN SHOWN IN FIG. 2

FIG. 4—PATTERN FOR LARGE SLIDE VALVE CYLINDER

Making Locomotive Castings-II

Specially Equipped To Make Cylinders



Assembling Cores Presents Difficulty

BY H. E. DILLER

OF ALL the castings produced in the gray iron foundry of the Baldwin company none presents as great a problem as is met with in delivering a satisfactory cylinder casting. Not only are the individual cores complicated, but great difficulty is encountered in locating the cores accurately and maintaining all of the large number of cores exactly in their proper positions. The metal, too, must be melted carefully and be of the proper mixtures to meet various chemical and physical requirements of the numerous railroads ordering locomotives. If dirt, shrink holes or slag holes are found in the casting, or if irregularities occur due to shifting of one or more cores it has little chance of passing inspection. Also, all faces must have a clean, smooth surface. To guard against defects complete laboratory control of melting and mixing the iron is maintained. Tests are made as required by the purchaser and as the laboratory feels are necessary to maintain the quality of metal.

When locomotives first were built molding cylinder castings was comparatively simple as they were much smaller than at present and less complicated. Then it was not a great problem to set the cores, one by one, in the mold, but now the mold necessarily is so deep and the cores so large and so numerous that it is almost impossible to make a mold and set the cores in it one by one. One method is to jar the drag and build up the cores in their position before setting them in the drag. After the cores are assembled they are lifted by straps carried on a crane, and set on the drag. The Baldwin company found this method is apt to cause the cores to slip slightly from their positions as they are lowered into the drag. Therefore, it decided to devise a better method of molding cylinder castings. The method which is described in this article was worked out in the company's foundry and has been patented.

The characteristic features of the method are simple drag and cope patterns; a cast-iron flask with one end hinged, the hinged end facilitating putting the pattern into the box and stripping the box from the mold after it is made; and pits lined with cast iron to receive the drag

Details of Molding

MOLDING methods in the production of locomotive cylinders are covered fully in this, the second article describing the foundry of the Baldwin Locomotive Co. This company has developed a special process for these castings which will be highly interesting to all classes of foundrymen, and which affords new ideas in foundry work. The entire article is devoted to this single subject. The final article of the series will be published in the Feb. 15 issue of THE FOUNDRY. *This describes the plan and equipment of the foundry, and the methods of handling the iron.*

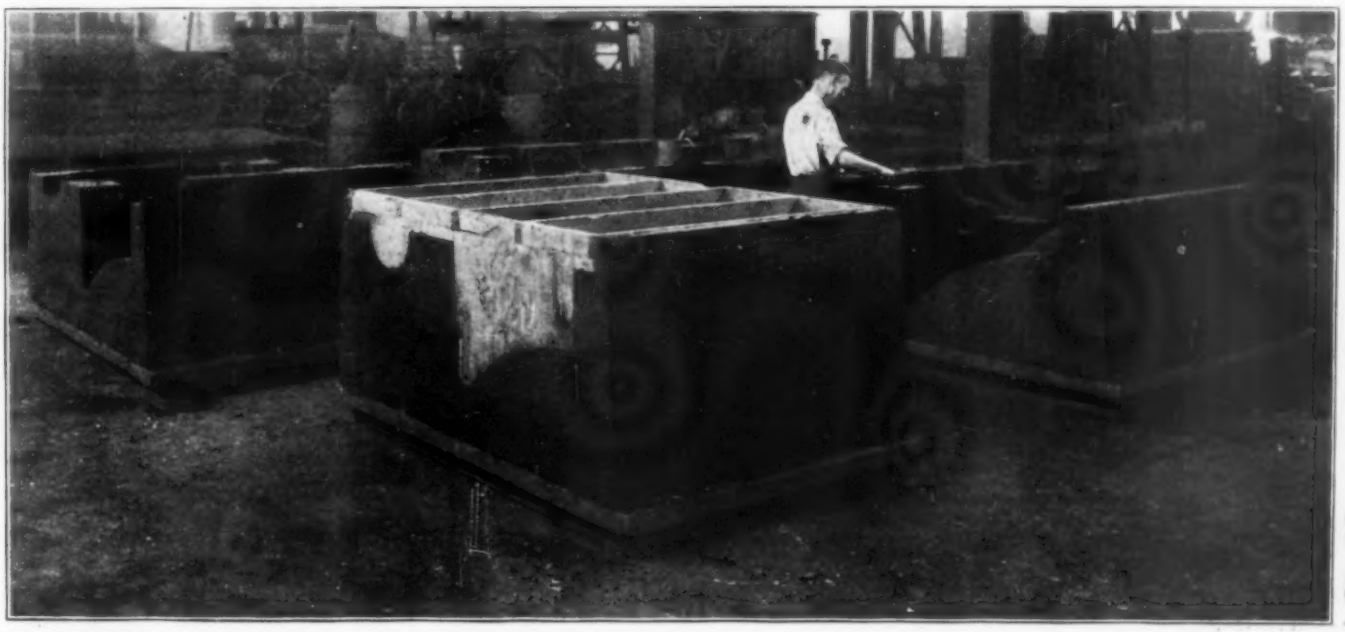
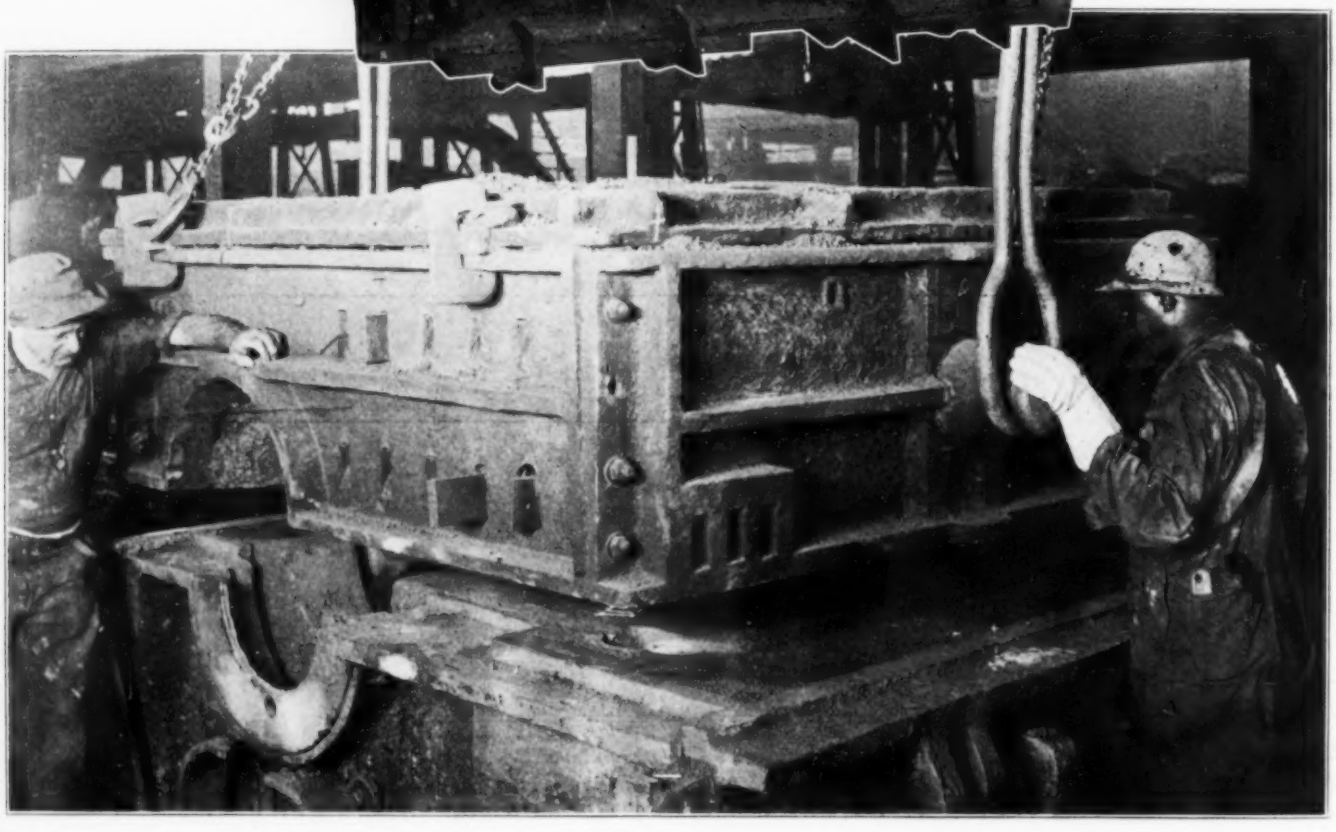


FIG. 5—A DRAG CORE AFTER THE MOLDING FLASK HAS BEEN REMOVED BY THE CRANE IS SHOWN IN THE CENTER—AT BOTH SIDES MAY BE SEEN DRAG CORES WITH THE PATTERN DRAWN

FIG. 6—ABOVE—DRAG MOLD READY FOR TRYING ON THE COVER CORE FIG. 7—RIGHT—SETTING THE RAIL CORE

FIG. 8—BELOW—TRYING ON THE COPE OF A CYLINDER MOLD—NOTE THE BARREL CORE HAS NOT BEEN SET



on which some of the cores have been set. These pits extend a short distance above the floor level and so the molder is enabled to set the remaining cores without bending or kneeling, the top of the pit flask coming to the molder's waist line. The amount of equipment necessary may be estimated more closely when it is realized that more than 100 tons of metal is poured into 18 or 20 cylinders each day in normal times.

The casting pits are arranged in two floors, one containing 24 and the other 36 pits. The pits extend 7 feet below the floor level and 31 inches above. The molds in one section are closed and poured one day while in the other section the drags are being set and cored to be closed and poured the following day. Thus the molds in one section are poured one day and those in the other section the next day. To clear the pits for molding the day after pouring, the entire mold and casting is lifted out of the pit about 2 o'clock in the morning. These molds are set on one section of the floor, and the castings allowed to cool with the sand on them for from 12 to 18 hours before being carried by the crane to the cleaning room.

The only patterns required are the simple board with a semicylindrical pattern for the cope, and the pattern for the drag core, or mold—either term might be applied. Patterns for a number of different types of cylinders are shown in Figs. 1 to 4. The pattern for the drag core, also is of simple construction, and is made of wood, as the number of cylinders ordered off any one pattern is not large enough to warrant making a metal pattern. The drag pattern is mounted on a board 2 inches thick and ribbed on the back. The ribs may be noted on the pattern in the mold, Fig. 5. The board is placed on the bottom plate of a cast-iron box having an open top. All of the boxes are 44 inches wide, but vary in length, the standard lengths being 32½, 47½, 50⅛, 55, 57½, 65 and 72 inches. Thus all the pattern boards fit close to the sides of the drag flask or box and are butted against one end, a sand strip forming at the other end if the board does not fit against it. This locates the one end of the drag mold so that when put in the pit the cores will bring the barrel section at the proper place. It also enables the molders to match the cope more readily than if a variation from the barrel end was allowed.

The mold is rammed by jolting on a plain jolt machine made by the Herman Pneumatic Machine Co., Pittsburgh, of which two are reserved for this purpose. A heavy cast-iron bottom board is clamped on after the sand has been struck off, then the mold is turned over by the crane which also lifts the box off the mold, leaving it on the mold as shown in the center, Fig. 5. One side of the box is hinged on the end which is down when the mold is being made. This allows it to swing back a short distance and this facilitates putting in the pattern. After the pattern is set in the box, the hinged side is wedged in place against strips in the mold and held there until time to lift the box from the mold. Then the hinge is up and the end which is down is allowed to swing loose from the mold, facilitating the draw.

When the box is off the mold, it is easy to draw the pattern with the crane, it being in the position shown in Fig. 5.

The mold then after being patched and slicked is blacked and put into the drying oven. To handle it, two round steel bars formed into a V with each end bent in the shape of a hook are inserted into the plate, one at each side. This is illustrated in Fig. 11 which shows drag molds after they have been dried and are being fitted with cores. Only a portion of the cores are set at this stage, just enough being used to bring the mold to the proper height when set in the casting pit.

These cores, all of which are shown in Fig. 9 include the exhaust and chest core, 8; live steam flange core, 16; saddle core, 14; and lighteners for the saddle core, 4, and the exhaust, 7. After the drag has been set in the pouring pit sand is rammed around the sides of it and the loose end of the casting pit which had been moved away to facilitate putting in the drag is brought flush with the bottom plate and wedged against the mold. Then the other cores are set beginning with the center lightener, 15, Fig. 9, which forms the front wall of the exhaust and back wall of the live steam and port cores. Two port cores, 3, are required, also an apron core, 9, which forms the front wall of the live steam port. After the side lightener core 10 and 11, the two side cores, 13, and top steam core, 5, have been placed

FIG. 9—FIFTEEN DIFFERENT CORES BESIDES THE COPE AND DRAG ARE REQUIRED TO MAKE A CYLINDER CASTING
1—Rail core. 2—Top lightener. 3—Steam port. 4—Saddle lightener. 5—Top of steam core. 6—Back slab core. 7—Exhaust lightener. 8—Exhaust core. 9—Apron core. 10—Side lightener. 11—Reversed view of No. 10. 12—Covering core. 13—Side core. 14—Saddle core. 15—Center lightener. 16—Live steam core

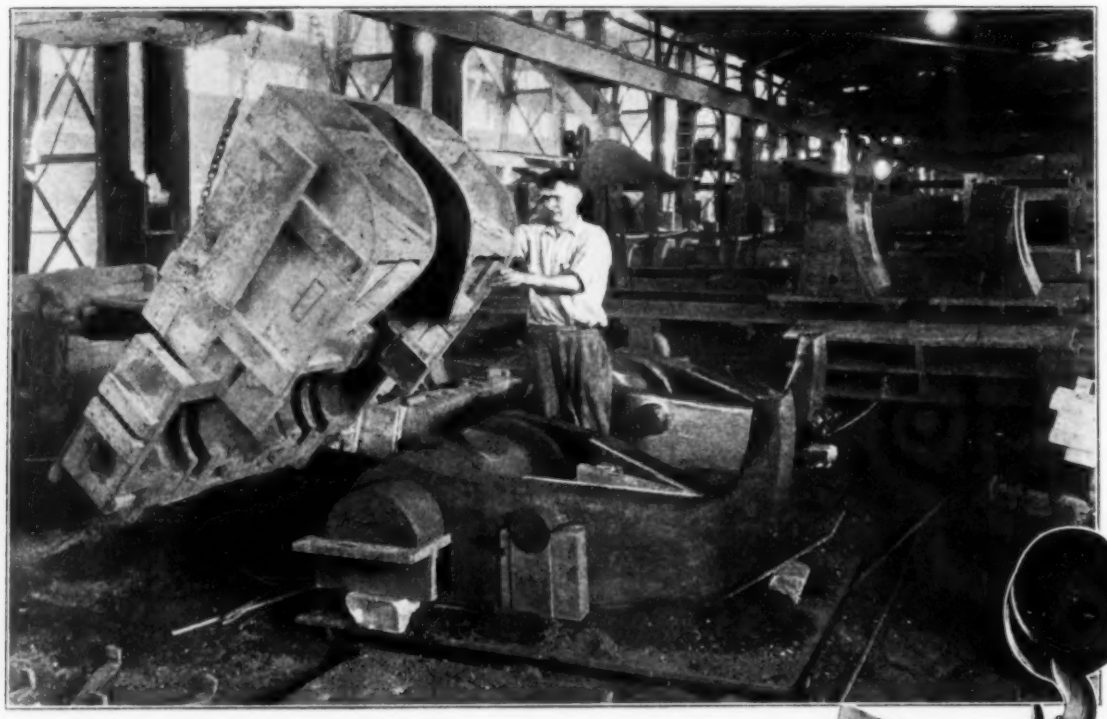
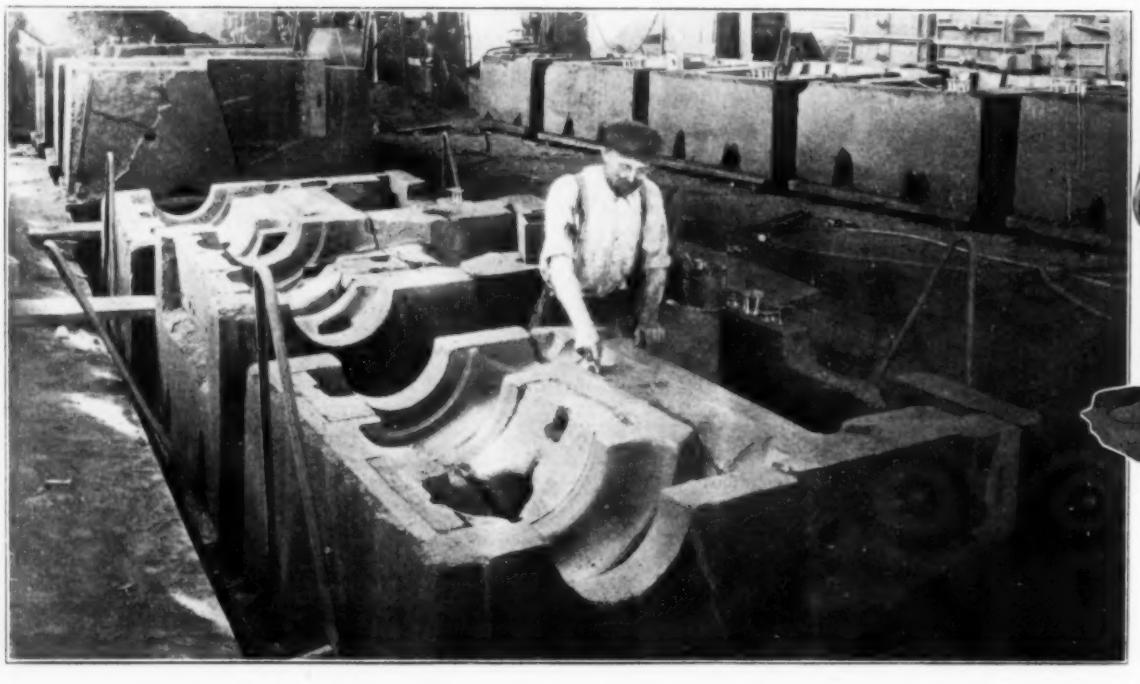


FIG. 10—ABOVE—ROLLING OVER THE LARGE STEAM CHEST CORE ON TO THE DRYER PLATE—HALF OF THE BARREL IS DRIED SEPARATELY AND FITTED TO THE MAIN CORE LATER FIG. 11—BELOW—SETTING THE CORES IN THE DRAG SECTION BEFORE IT IS PLACED IN THE MOLD FLASK FIG. 12 —RIGHT—THE STEAM CHEST CORE IS MADE WITHOUT ARBORS AND IS CARRIED BY THE CRANE WHEN DRIED



the back slab core, 6, and the covering core 12 are set.

Fig. 6 shows a mold ready for trying on the cover core. The drag has been set in the pit with the bottom plate resting on four steel bars which extend into slots in the wall of the pit which is lined with cast-iron plate. Four rows of these slots are arranged up and down along the sides of the pit, a row along the edges of two opposite sides. The steel bars are put in the proper slots to give the mold the correct height before the drag is set in the pit, finer adjustment is secured by laying shims on the supporting bars. When the movable end plate is pressed against the mold short pieces of round steel bars are inserted in holes along a flange on the pit. The end plate is then forced more strongly against the mold by wedges driven between the steel bar and the end piece. This is indicated at *A*, Fig. 6. This illustration also shows the method employed to allow some of the gases generated on pouring to be taken off the sides of the pit. Sections of the cast-iron end walls of the casting pit are left open. Then perforated plates, as indicated, are fitted in front of flanges on extension ribs and sand is rammed between the plate and the cores. Ropes are laid in the space leading to the cores and out through the holes in the plates. Then after the sand has been rammed the ropes are pulled out and leave a clear space for venting. Sand also is rammed carefully around the flask at the points where the barrel core rests, *B, B*, Fig. 6. Rolls of fireclay are laid over the print of the barrel core, to form a seal. The cope which is rather simple, forms the upper section of the cylinder barrel and contains only one core. It is bumped at night on a plain jarring machine in a heavy cast-iron flask and a plate is clamped on top. After it is blacked and dried the rail core is put on, as shown in Fig. 7. This is a comparatively small core, and as it hangs down in the mold, must be supported to prevent it from falling. To accomplish this two ⅜-inch round rods are molded into the core and held by a strap which sets against cross bars in the mold. The core is set, as in Fig. 7, and later the cope is rested on two parallel walls to allow the molders to get underneath and fasten the strap, screwing nuts on the ends of the rods.

Before setting the barrel core, the cope is tried on the drag, as shown in Fig. 8, and the two are marked with a scribe on chalked sections so that they may be fitted together at the correct position after being taken apart to set the barrel core. Sometimes in matching the cope to the drag, slight modifications are made by cutting away the sand or filling in a little sand. In such cases care is taken to dry the sand added as blowholes would be apt to result from wet sand and the molders working on the job are held strictly responsible for the casting. The company has endeavored to get away from this method but the combination of flask and core joints seems to make any change impossible.

Drying is accomplished by applying charcoal fires in perforated sheet steel boxes to the damp spots, or by the use of an oil torch. As each workman as well as the foreman over him is held responsible for the quality of the castings made as far as it is affected by his work, he is careful to see that no damp spots are allowed to remain on any of the cores he sets, and he examines each core carefully before it is set in the mold. Chaplets are used only where necessary to support the cores, and vary in length from 1⅞ to 3 inches, according to the thickness of the walls at the points where they are placed.

The metal is poured through one down gate along the back flange of the cylinder. Four sprue gates located at different heights feed the metal to the casting. At times good results are obtained without the use of risers, but at other times it is found advisable to put a riser over the cylinder head and over the rail. The pouring basin is formed of dry sand in a cast-iron box. As has been noted in the early part of this article, the entire mold is picked up by the crane about 2 o'clock in the morning after pouring and is carried to a section of the floor

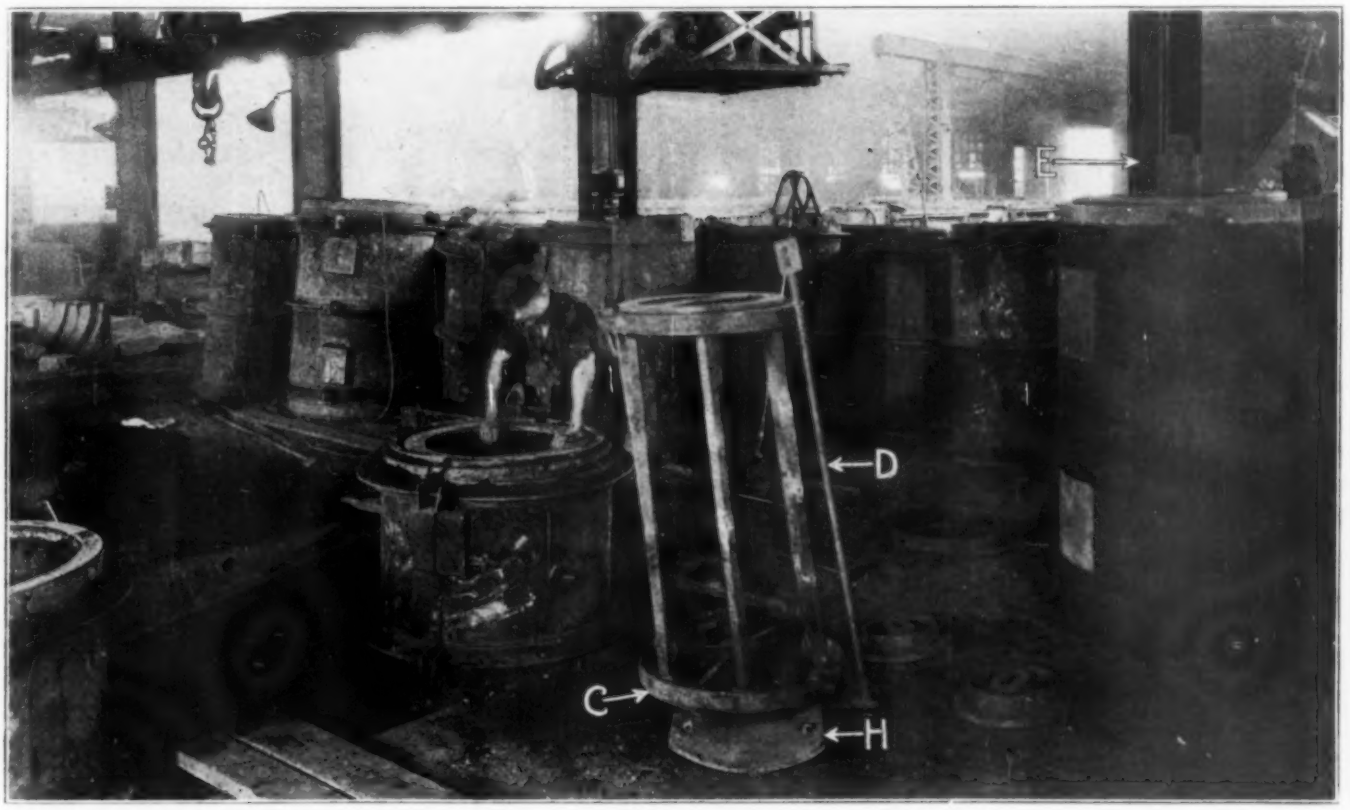


FIG. 13—CYLINDER BARREL CORES ARE MADE ON AN ARBOR, A BARREL PATTERN FORMING THE HOLLOW CENTER—NOTE THE DENSENERS ON THE CORE AT THE RIGHT—THE ARBOR, FORMED OF FOUR BARS AND TWO END PIECES, IS SHOWN

set aside for this purpose. Here the molds are allowed to stand with the castings in them for from 12 to 18 hours. This gives the castings opportunity for self-annealing. The mold is picked up readily by the crane which is attached to the V-shaped bars used to handle the drag in setting it in the casting pit.

The most intricate work in the production of cylinder castings is making and setting the cores. In fact, so little of what might be called molding work is required that no skilled molders are put on the job, but the coremakers and coresetters must be highly expert. From what has been explained about setting up the mold it readily may be understood that expert coresetters are required. A description of the production of some of the more complicated cores will bring a realization of the skill required by the coremakers.

All cores are made of a mixture of sand and gravel of such texture that when mixed with the dry compound used they will stand hard ramming, and when baked will vent well and be strong. What is accomplished is indicated by the exhaust and steam-chest core shown in Fig. 12. No arbor is used, only a few rods. That the core does not break or become distorted when dried is said to be due partly to the sand mixture and the heavy ramming which it receives.

The core is rammed in the box shown in Fig. 10, and is complete with the exception of one half of the chest core which later is pasted on and tied with wires around the end prints. After the core has been rammed two crane chains are attached to the under side of the box which is rolled over on the drier plate covered with sand to receive the exhaust end, and having a cast-iron plate plate on legs of the proper height arranged to receive the chest end. After it is rolled over several small loose pieces are withdrawn, then the box is lifted by the crane, the coremakers rapping and steadying it. After the box is off a loose piece remains to be drawn on each side and the large section in the center must be lifted out. Also ropes which have been embedded in the sand to form vent holes are drawn. The ends of two vent holes may be noted in the end of the chest section, Fig. 12. This illustration also indicates the method used for handling large cores with woven textile bands on a yoke. A similar yoke having a cast-steel wheel at each end, grooved to carry chains, is used for lifting flasks. The chains moving on the wheels permit the object being carried to be turned. In case it is desired to hold the object steady the chains are slipped off the grooves of the wheels and are thus prevented from turning.

Cylinder barrel cores are made in an entirely different manner from the cores for the liners, which were described in the first article of this series. The barrel cores are rammed on a cylindrical arbor composed of two heads with four connecting rods. The arbor is indicated in Fig. 13, which shows a core almost finished in the pit in which the cores are made. To begin the core, the lower ring, *C*, Fig. 13, is placed in one of the pits, of which two are used for molding the barrel core. The four rods then are set in recesses on the rim of the ring and after the mold is rammed the top ring is put on. To hold this loose arbor steady, a center rod *D*, is employed. The lower end of this rod is forged with extensions on opposite sides. Slots in the cross pieces of the rings allow the end of the center rod to slip through. After it is through both slots, the rod is turned and the extensions on the lower end engage the sides of the slot in the cross piece of the lower ring preventing the rod from coming out. Rings slipped over the top of the rod support a wedge which extends through a slot in the broadened top of the center rod and clamps the two ends of the arbor together firmly. This is indicated at *E* on the finished core, Fig. 13. The corebox is built of two sections bolted together.

Before the top ring is finally put in place, a cylindrical box which forms a hollow in the core is set on and the sand shoveled in and rammed. With the center hollow, the wall of the core is only 2½ to 5 inches thick, depending upon its diameter. This thin wall of sand is held by the four bars of the arbor and by three or four strands of wire

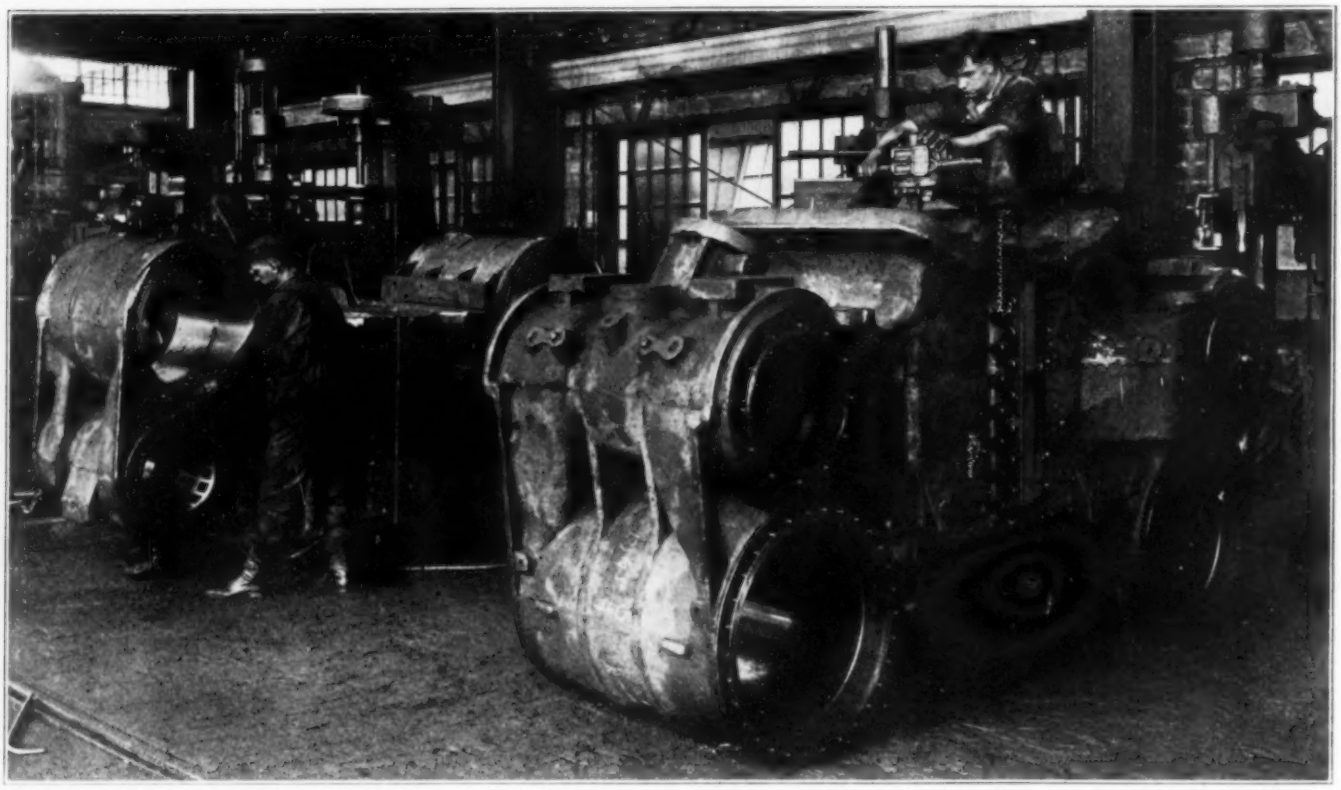


FIG. 14—THE IRON IN THE STEAM CHEST AND CYLINDER BARREL MUST BE CLOSE GRAINED AND FREE FROM FLAWS —STRONG IRON IS REQUIRED IN THE FLANGES

wound around the four bars at different heights.

Two densener plates of cast iron, one of which is shown at *H*, Fig. 12, are set in the core as indicated in the core at the right. The side of the densener plates which is against the sand is coated with clay wash, and after the corebox has been taken off the joint of sand and metal around the plates is slicked carefully. The denseners are placed so they will be in the mold opposite to the *K* section formed by the juncture of the strengthening ribs and the cylinder proper.

After the sand is rammed the center section of the corebox is drawn by the crane, the coremakers rapping it by striking a steel ring around the top of the box with mallets. The sand is then cut flush with the ends of the four bars and the top ring is put on and anchored as described. To draw the core from the box, the crane chain is hooked under the cross piece on the upper ring and the core together with the box are raised off the bottom of the pit. The coremakers then strike the sides of the box with mallets until the box slips off the core. Two gangs consisting of a coremaker and a helper work on this job and make 96 to 100 cores in five days. One of the big advantages of this core is that the arbor can be removed quickly after the casting is made. This is accomplished by knocking out the wedge which holds the center bar. This loosens both end plates which then easily can be taken out allowing the four bars to fall.

Makes Wood Lined Steel Flasks

BY J. R. ARNESON

SEVERAL years ago in an endeavor to find a satisfactory substitute for wood flasks, we cast a few experimental steel flasks after the style shown in Fig. 1. The principal advantage of a wood flask, after its lightness, is that the bars easily may be changed to suit various patterns. In a jobbing iron and steel foundry these changes are made constantly. In the steel flask shown, slots were provided at each side for the reception of bars that may be tightened temporarily and afterward changed as occasion arises. The steel flasks served their purpose admirably in some respects, but the molders claim those designed to be handled by hand are too heavy.

Later we had occasion to provide many new flasks and after carefully considering the merits of every form of construction with which we were familiar, we decided on the style shown in Fig. 2. These flasks are made in any convenient size from steel channels, with the channel side turned in and with the sides and ends riveted at the corners. We had a pattern prepared and cast steel handles similar to those shown in the illustration. The handles were riveted in place. Cast steel lugs were attached at each end to serve as guides and guide holders. Cope and drag lugs were attached approximately in line with each other and then a hole was drilled through both. In this manner a close and accurate fit was secured. A structural iron company in the city fabricated the flasks and attached the handles and guides according to directions. All the joints were riveted and after being in use for several years it seems reasonable to assume that the joints will remain rigid.

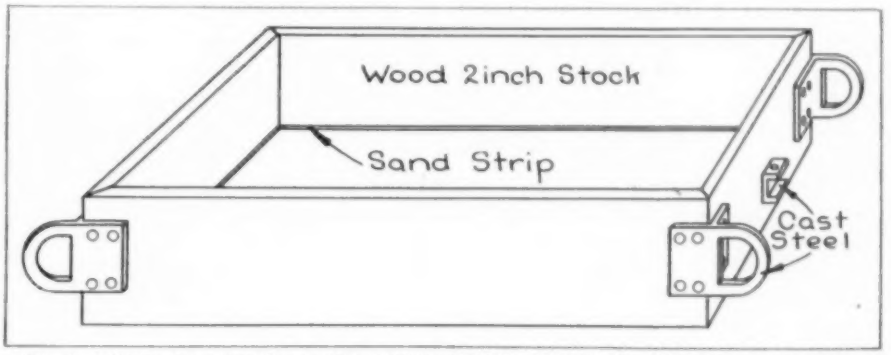


FIG. 2—TYPE OF FLASK MADE FROM STEEL CHANNEL BEAMS LINED WITH WOOD

After the flasks were delivered to the foundry they were lined on the inside with suitable pieces of 2-inch plank. The edge of the channel projected a slight distance inside the plank top and bottom on all four sides and served as a sand strip to help retain the sand in place. The pieces of plank were jammed in tightly to prevent any play later when the flask was filled with sand. The two ends were fitted first and followed by the side pieces.

This style flask easily is fitted with wood bars cut to any desired shape. It combines the rigidity of a steel flask with almost the lightness of a flask made of wood. At any time the bars easily and readily may be knocked out and replaced by others. By observing proper precaution, good bars may be removed without being destroyed. Handles similar to those shown in the illustration are attached to the smaller flasks.

On the long flasks the handles are attached to the sides in a manner to equalize the weight between the handles and the ends of the flask. We have adopted this type of flask almost exclusively and find it particularly well adapted to a line of general jobbing work, in which changes in the bars constantly are being made. We also have noted that our lumber bills have been reduced.

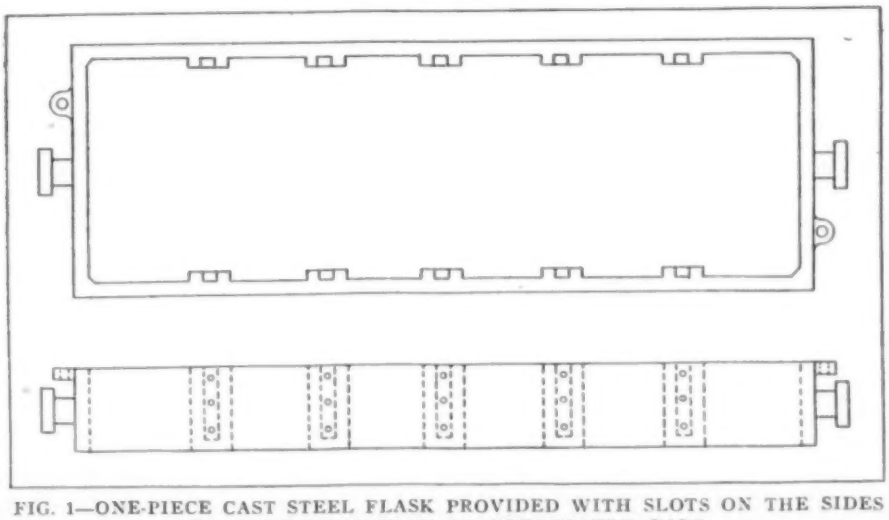


FIG. 1—ONE-PIECE CAST STEEL FLASK PROVIDED WITH SLOTS ON THE SIDES FOR THE RECEPTION OF DETACHABLE BARS

Explains Use of Magnesium

Peculiarities of the Metal, Which Readily Can Be Handled by the Foundryman Are Pointed Out—Features of Molding and Design Discussed and Means Avoiding Defective Castings Shown

BY H. J. MAYBREY

IN 1914 magnesium had not long ceased to be practically a chemical curiosity. Outside the laboratory and certain foundries it was familiar, only to a limited public, as ribbon or powder. This does not mean that the metal had received no attention from the practical metallurgist; on the contrary magnesium was, in small percentages, an essential constituent of several alloys. One of these, duralumin, was at that time being produced in considerable quantities. Moreover, in various parts of the world, a great deal of research had been done with a view to the development of those alloys in which magnesium formed the main constituent. Nevertheless, magnesium occupied a lowly position among those metals which engaged the attention of the majority of foundrymen.

The demands of the war stimulated the world interest in aeronautics. The consequent call for lighter structural materials greatly increased the foundryman's interest in magnesium, in spite of the comparativly high cost of the metal. The outcome of this interest has been to bring into operation cheaper and more satisfactory methods of manufacturing the metal. Most of the methods in use today are based upon the electrolysis of the fused anhydrous magnesium chloride. Other methods employing distillation are in use and seem to work quite successfully. The requisite ores for these processes exist in enormous quantities, and are widely distributed over the surface of the earth.

Magnesium Cost on Decline

A cheap and efficient process operating on raw material which is abundant is the main condition necessary for the production of an inexpensive metal. The increasing demand for the metal is steadily lowering its cost. Even now, its price is no longer a bar to its use for a large number of purposes. Moreover, as the price of the metal is lowered the field of application for the various magnesium alloys will increase rapidly. Today magnesium and its alloys are produced commercially in the following forms, and for the various purposes indicated.

Powder, in all meshes, for photographic and illuminating purposes.

Ribbon, for photographic and illuminating purposes.

Sticks, for use as a deoxidizer in brass and steel foundry practice.

Chill and sand castings, in various forms as pistons, carburetors, crankcases, connecting rods, pulleys, etc.

Sheet metal for various uses.

Extrusions, stampings, drop forgings, etc., for various uses.

Notched Bars Supplied

Magnesium is usually supplied to the foundry in the form of notched bar ingots, similar to the usual aluminum notched bar. It is sometimes supplied as sticks about one inch in diameter, or as flat plates. When it is obtained from manufacturers of repute, the metal is almost chemically pure. Magnesium less than 99.4 per cent pure is considered of a poor grade.

Before buying magnesium metal, the foundryman should make an inspection and note the following points. He should, in the first place, be satisfied with the analysis given for a fair sample of the metal offered. He should note the appearance of the weathered surface of the ingots. He should cause a slab to be broken freshly and should examine carefully the rough fracture. It is, of course, well to have a bright, clean outside surface to the ingot. Often when the ingot is being cast a slight oxidation of the metal will cause a blackening of the skin of the block. This is no serious drawback, provided, the rough black surface is not too deep.

The presence of gray crumbling spots on the ingot surface should, however, be looked upon with the gravest suspicion. On a freshly fractured surface these spots appear like small slag inclusions. They are due to what the manufacturer calls flux inclusions.

Magnesium chloride, from which practically all commercial magnesium is manufactured, is an extremely deliquescent substance. The densities of molten magnesium, and of the molten chloride from which it is produced, are only slightly different, so that there is a tendency during the process of casting the metal into ingots, to get a certain small amount of magnesium chloride entangled in the solid metal. Only the exercise of a great amount of skill and care on the part of the manufacturer can cause the ingot metal to leave the works free from contaminations of magnesium chloride. It is obvious that metal containing flux inclusions is likely to be a source of much trouble to the founder. Such metal, when melted and poured into molds, will produce a casting whose surface is likely to be marred by these unsightly flux markings. Apart from appearance, these inclusions are likely to injure the mechanical properties of the metal, and be a fruitful source of local corrosion.

Keep Bright Surface

This intensely local pock-mark corrosion of castings, due to the presence of deliquescent flux on the surface, must not be confused with the ordinary atmospheric corrosion from which magnesium, in common with nearly all metals, suffers. A bright clean surface, much whiter than with similar aluminium alloys, can be obtained from magnesium alloys cast into sand or chill mold, if proper precautions are taken. Such castings will keep this surface for some considerable time, but gradually, if left in one side, a thin

Alloys Stronger Than Pure Magnesium

	Pure metal — Tensile strength, pounds per sq. in.	Pure metal — Elong. per cent	Alloy, 6 per cent aluminum — Tensile strength, pounds per sq. in.	Alloy, 6 per cent aluminum — Elong. per cent	Alloy, 8 per cent zinc — Tensile strength, pounds per sq. in.	Alloy, 8 per cent zinc — Elong. per cent
Chill cast	17,700	4	25,750	5	24,200	3
Bottom poured	16,350	5	21,050	5	21,300	4
Sand cast	15,200	5	19,950	7	20,400	4

Paper presented at the International Foundrymen's congress, held in Paris, Sept. 12 to 15. The author is a member of the Institute of British Foundrymen.

grayish film, the result of atmospheric oxidation will cover it. This film will be quite firm and not inclined to rub off, also, it will act as a protective coating against further corrosion.

As with iron and aluminium, it is inadvisable to make castings in magnesium alloys that have to withstand immersion in water, unless the castings can be suitably protected from water corrosion. In the case of magnesium alloys this applies especially to salt water.

It is perhaps unfortunate that magnesium is familiar to the world at large chiefly in the form of powder and thin ribbon which readily is ignited. The idea this implies, that magnesium alloys are in grave danger of being set afire with ease, is incorrect. It is certainly true, that given a sufficient supply of oxygen, magnesium powder can be set afire. Incidentally, given a sufficient supply of oxygen, aluminium powder has been the cause of some terrible explosions; iron filings, too, are readily burnt.

Burning of Magnesium Explained

Two conditions are necessary for the rapid burning of magnesium. The first of these is that the metal must be at a temperature at least as high as its melting point. Secondly, that the metal must be supplied with plenty of oxygen. Obviously these conditions readily can be fulfilled in the case of magnesium ribbon. A match applied to the end of the thin strip supplies sufficient heat to cause a little of the metal to melt, while, owing to its elongated shape there is a free access of air. This causes the rapid burning of the metal accompanied by the well known white light and great heat. The heat developed is more than sufficient

FIG. 1—GAS HOLES CAUSED BY IMPERFECT COMBUSTION IN THE DRYING OVEN

FIG. 2—SECTION OF A CYLINDRICAL BLOCK 5 INCHES IN DIAMETER

to melt the adjacent piece of the strip which in burning liberates yet more heat; and so on.

It is obvious that these conditions are not so easily complied within the case of a casting. In the first place, magnesium is a singularly good conductor of heat, so that great heat supplied at one spot tends to be distributed quickly throughout the mass of the casting. Moreover, if an intense local heating causes one portion of the solid mass of the metal to melt, the crust of oxide formed by the burning tends to prevent oxygen from reaching the metal behind it; apart from the fact that the heat developed by the burning of the small spot is rapidly conducted throughout the mass of the casting. Nevertheless, if enough heat is supplied to the magnesium casting, it will melt, and as molten metal it is useless for engineering purposes. Therefore, no one would cause magnesium castings to be used in such positions as would render them likely to be melted while performing their normal functions.

Little Danger From Burning

To anyone who has had even a small experience of handling magnesium, these remarks about burning must be unnecessary. However, it is surprising how these misconceptions persist. It is amusing to note that less than three months ago, at a certain international air congress held in London, a distinguished metallurgist of world wide repute, solemnly warned the conference against the use of magnesium alloys on the grounds of their inflammability.

Magnesium with its great affinity for oxygen is sometimes used as a deoxidizer for brass and steel. The quantity used in each case is extremely small, around 0.02 per cent. Care must be taken to see that the magnesium, usually in the form of stick, 1 inch in diameter, is pushed well down below the surface of the molten metal, so that it does not burn away wastefully on top. It is not desirable to use such a quantity of magnesium that much is left over from deoxidizing the brass or steel to form an alloy.

Magnesium should be melted in iron or steel pots. As it does not alloy with iron to any appreciable extent, it is not necessary to coat the pots, as would be the case with aluminium alloys. The use of graphite pots in melting magnesium is not to be recommended, owing to chemical interactions, resulting in contaminated alloy and short life for the pot.

Many important points must be observed in melting magnesium. The free access of air to magnesium or magnesium alloy, and the continual exposure of fresh molten surfaces are conditions favorable to the production of nitrides and oxides. The presence of either of these compounds in a casting, even in small quantities, will have a detrimental effect upon the physical properties of the casting. It is essential, therefore, that means be taken to prevent the formation of these harmful compounds.

Melted Under Chloride Flux

An old method of doing this was to melt the metal under a chloride flux. This flux was formed of varying proportions of the chlorides of sodium, potassium, and magnesium, sometimes with the addition of a small quantity of potassium fluoride, with ordinary care, and using such a flux, magnesium may be melted, alloyed and cast with practically no burning. Unfortunately

FIG. 3—TOO LIGHT SECTION CAUSED HOLE TO BE BURNED THROUGH PISTON HEAD

when metal melted in this manner is cast, it is almost impossible to prevent small drops of the molten flux from entering the mold with the liquid metal, and so contaminate the casting with flux inclusions. These inclusions, containing a high percentage of magnesium chloride, are deliquescent. They are fruitful sources of local corrosion, and loss of strength.

As manufacturers of the ingot metal have been at considerable pains to produce a metal free from chloride inclusions, it would seem that such a method of melting negativates their efforts. Therefore, the foundryman is recommended not to use this method, but rather to adopt the procedure which is about to be explained.

For the sake of example let it be assumed that it is desired to produce castings in an alloy of aluminum, 6 per cent; magnesium 94 per cent. The melter should take a pot that is perfectly clean, and place a small quantity of magnesium in the bottom of it. He should melt this magnesium, taking care that the temperature of his metal does not rise more than a few degrees above the melting point. During this proces of melting, a tightly fitting lid should be kept upon the pot. The quantity melted, in this first operation, should be enough to fill the pot about one-quarter full when liquid. Fresh lumps of the solid metal, previously warmed, then should be dropped into the molten pool, at such a rate as will allow the metal in the pot just to remain melted. Finally the calculated quantity of aluminum should be added to the melt, and the whole be stirred vigorously enough to insure a uniform mixture. During the melting, a tightly fitting lid should be kept upon the pot, and only removed for the purpose of adding fresh metal, stirring, etc. These operations should be done in the shortest possible time. If the temperature of the metal is properly regulated by pyrometric observations, and air excluded as much as possible from entering freely the top of the pot, the alloy can be made up with but a slight amount of burning.

Temperature Should Be Low

The temperature of the metal at the moment of casting should be as low as is consistent with filling the mold, and the demands of feeding the casting. This temperature is not definite for any particular alloy. It depends upon the type, temperature and intricacy of the mold. Naturally only experience can determine what this temperature should be in any particular cast.

When the metal is melted, and the alloy formed, a certain amount of oxide skin is inevitable. This skin must be removed by skimming immediately before casting. It is the author's experience that the alloy should be cast directly from the pot, and not ladled. This means that the amount of metal melted should be sufficient only for the particular work in hand. If a number of small castings have to be made, a small pot should be employed, so that the pot itself becomes, in effect, a ladle.

The amount of heat developed by the furnace must be subject to rapid control. Such control undoubtedly is obtained most easily in electrically heated furnaces. Unfortunately, we have yet to be convinced that electric melting of metals is universally the cheapest method. Accurate heat control can be obtained by suitably designed gas or oil-fired furnaces. Possibly the best type of gas-fired furnace is the one employing natural draught, as an even heat is then obtained. The injector type gas-fired furnaces are apt to be local in their heating. It is the author's opinion that coke-fired furnaces are not convenient for the melting of light or ultralight alloys.

From what has been said, it is obvious that the ratio of the surface of the molten metal exposed to the air, and the volume of the liquid metal in a pot, should be a minimum, to lessen the chances of burning. Therefore, the pots used in the melting of magnesium alloys should be designed to ensure this minimum. They should be long, and narrow in proportion.

It would seem unlikely that magnesium alloys are suitable for pressure die-casting. However, excellent results have been obtained from casting the alloy into complicated chill molds. Such a method is sometimes called die casting. An excellent finish is obtained in no ways inferior to similar castings made in aluminum alloys.

It is only of recent years that castings in sand molds have been made regularly in magnesium alloys. This, no doubt, was due to the general state of the magnesium industry, and not to any particular difficulty in sand casting the alloys. It is obvious that while casting in permanent chill molds is a suitable method to use with magnesium alloys, the majority of castings required do not permit of the use of such molds, either from the reason of complication or expense. Castings obtained by using sand molds are satisfactory.

Every metal has its own peculiarities in the foundry, and magnesium is no exception to this. The special conditions obtaining in a foundry devoted to the production of cast iron are not likely to render that foundry suitable for castings of magnesium alloys. On the other hand, aluminum foundry practice only will require adaptation in certain details. These details are ones of treatment rather than layout.

Moisture May Prove Dangerous

At high temperatures magnesium interacts violently with water, and gases are evolved. Therefore, it should be the earnest endeavor of the foundryman to keep molten magnesium and water as far apart as possible. For example, while the metal is liquid in the pot, anything that is brought in touch with it, such as fresh metal, stirring rods, pyrometer ends, etc., should be rendered free from moisture before being placed in the already molten magnesium. Therefore, it is common sense, that when the metal is to be cast, precautions shall have been taken to render the mold and cores dry, and free from water in any form. The mold may contain water in more than one way. The sand may be damp with rain or added water, or the sand may contain constituents which have combined water in them.

If the mold and cores are baked thoroughly, the water that is mechanically mixed with the sand can be driven off. It is surprising how long the baking takes, and only experience, and sometimes the length of time required by a certain mold can be determined only by trial.

It is the author's opinion that coke-fired drying ovens are preferable. When gas-fired ovens are used, it is of the greatest importance to see that perfect combustion of the gas is obtained, as only then will satisfactory results be obtained. With incomplete combustion curious blowholes appeared on the surface of the casting. Such holes are shown in Fig. 1, on the inside surface of the piston. The mold was dried in a coke-fired oven, but the core was dried in an oven fired by gas. The temperature of the core oven and the length of time during which the core was baked made certain that the core was dry. A probable explanation is that, owing to incomplete combustion the small quantity of hydrocarbons, present in the city gas supply, was condensed on the core and not burned off. However, this matter which has been a source of much trouble is still under investigation. The present opinion is that it is preferable to use coke-fired ovens, which have always given good results.

Fig. 2 shows a section of a solid cylindrical block, 5 inches in diameter.

The blow holes are due to insufficient drying of the mold. With comparatively large blocks of metal which, after casting, are likely to remain molten for some time, the mold drying process should be carried on for some considerable time.

The type of sand to be used for magnesium castings is an important factor in the production of good castings. The percentage of clay in the sand should be low. This will keep the combined water percentage down. The sand should be of an open, porous type so that the gases formed during the process of casting can be conveyed away easily. While this is a necessary condition of casting with all metals, it is of extreme importance with magnesium. A high silica sand is to be recommended in core making. Any of the ordinary core oils can be used as a binder. There is a field of much research work in the determination of the most suitable sands to use in the production of magnesium casting. The answer may be supplied by some naturally occurring deposit. Quite possibly the best sand to use is some artificially prepared mixture starting with a basis of pure silver sand.

Magnesium being such a chemically active metal, especially in the molten state, it is of the utmost importance that, while liquid, it is not brought into contact with materials with which it may react for a long enough time to produce observable effects. It is essential, then, that the chilling effect when the metal is cast shall be a maximum, so that the metal shall be in contact with the sand of the mold for as short a time as possible while it is molten. Sometimes it has been found in foundries with which the author is connected that there is difficulty in producing a certain casting in magnesium alloy. In such cases it has been found on occasions that at places of large section the metal has remained molten long enough to attack the sand, and there produce a surface on the casting in every way undesirable. It is usually found that the introduction of iron chills in the mold near these places of large section help to reduce, and finally do away with, this chemical attack.

The important question of design of castings and molds has not always received that attention from engineers which is urgently needed. This question is of great importance. Every metal or alloy has its own particular virtues which recommend it to the notice of the engineer for a particular purpose. It usually has, as well, little peculiarities which call for the use of much skill on the part of the foundryman. The engineer should take advantage of these natural assets of the particular metal. Moreover, he must make his drawing so that the foundryman can design the pattern and corebox in such a manner as will facilitate the speedy and successful production of castings.

An illustration will perhaps make this clearer. If Fig. 3 is referred to it will be seen that the piston has failed in practice owing to a hole being burned through the top of it. Here is a case where the foundryman had succeeded in making a really fine product, which failed through no fault of casting or of the properties of the metal, but rather to unsuitable design. Such a design does not take advantage of the superior heat conducting properties of this particular magnesium alloy. The designer was dealing with an ultralight alloy. He could have increased the thickness of the piston head to at least 50 per cent, and still left the piston considerably lighter than a similar piston in aluminum alloy. By doing so he not only would have increased the strength of the piston head, but he would have improved its capacity for heat conduction as well.

Magnesium alloys are more than four times as light as iron. Therefore, it will require a column of molten magnesium four times as high to produce the same pressure as a similar column in molten iron. This point must be borne in mind when designing runners and risers.

It may be fairly said that provided the metal supplied by the manufacturer is of suitable quality, there are no great difficulties with magnesium alloys in the foundry.

Magnesium foundry practice is based on the broad general laws of all foundry practice. It is only in the details of lay out and manipulation that differences occur. No special plant is required for magnesium foundry work; that is what makes such a paper as this so difficult to write. There is so little to say. A common sense appreciation of the chemical and physical peculiarities of the metal is all that is required.

Can Keep Malleable from Becoming Brittle

Deterioration in the quality of malleable cast iron is found to result when the iron is heated to within a critical range of between 500 and 900 degrees Fahr., and then is quenched, or cooled rapidly, to lower temperatures. This deterioration is marked by a lessened ability to resist shock, and is encountered, for example, in the hot galvanized process. Its fundamental cause is not yet known.

An investigation of this phenomenon made at the U. S. bureau of standards showed a considerable variation in magnitude as between different samples of malleable iron. The impact method of testing was used, and was found to offer a convenient means of measuring the degree of deterioration. The tests also showed that there is a fairly definite range of quenching temperatures to which the effect is limited. Aging after heat treatment within this range did not affect the results. The rate of cooling was found to have an important influence, the degree of embrittlement being materially lessened if the iron was cooled slowly instead of being quenched.

If, on the other hand, the iron was heated to a temperature some 200 degrees above the critical range, and quenched from that temperature, it was found to be materially more resistant to shock, and it also was rendered immune to embrittlement as a result of subsequent reheating to within the critical range.

These tests are described and the results given in *Technologic Paper No.* 245 of the U. S. bureau of standards entitled "Embrittlement of Malleable Cast Iron Resulting from Heat Treatment." Copies may be obtained from the superintendent of documents, government printing office, Washington, D. C. The price is five cents, cash.

War Department To Finish Liquidation

The war department announces that every effort will be made to clean up the remaining war surplus property before the close of the fiscal year which ends June 30. The first sale of importance is to be held in Boston on Jan. 17, followed in February and March with sales at army depots in Brooklyn, Chicago, San Francisco and San Antonio, Texas. These sales will be quartermaster auctions and for the major part consist of textiles, wearing apparel and general merchandise. Sales of an entirely different character are to be held shortly when certain large real estate and manufacturing plant holdings located in the United States and Canada will be sold.

War department officials assert that the success of the war department's liquidation campaign, which has sold in five years' time materials costing the government nearly three billion dollars, is due to newspaper and business paper advertising.

How and Why in Brass Founding

By Charles Vickers

Deoxidizers for Use in Nickel Silver

Some time ago we read an article in THE FOUNDRY *on monel metal which stated that aluminum is added to improve the alloy, the amount so used being up to 0.5 per cent. Also magnesium and manganese are used together as deoxidizers and produce a better result than either of these elements alone. We desire to learn if this combination can also be used for an alloy of 25 per cent nickel; 24 per cent zinc, and 51 per cent copper. If so, how much of these deoxidizers can be added.*

Both manganese and magnesium are used as deoxidizers in the case of nickel silver. Some prefer the one and others prefer the other. About 3 ounces of manganese copper containing 30 per cent manganese added to the 100 pounds of alloy produces good results. When magnesium is used the more modern way of adding it is as an alloy with nickel—a magnesium nickel, but a magnesium copper would be just as good. Use the 10 per cent magnesium alloy and commence with small additions first. If ¼ per cent ensures sound castings that is all it is necessary to use, but deoxidizing such alloys is exactly the same as deoxidizing copper to cast it soundly. It is a question of careful handling while melting, and some founders can use a small amount of deoxidizer, while it is necessary for others to use two or three times as much to get the same results, and their product suffers accordingly. Use as little as possible and get sound castings. If the alloy is not melted carefully no amount of deoxidizer will give sound castings. Probably manganese and magnesium could be used in nickel silvers with better results than either alone. This may be determined by a trial, using 3 ounces manganese copper, and 4 ounces of magnesium copper, or magnesium nickel per hundred pounds of alloy.

Mixing and Casting Nickel Silver

We have an inquiry for nickel silver and having never made the alloy we desire the following information; (1) *formula;* (2) *temperature metal should be poured, and color at that degree;* (3) *methods of molding, gating, sprues and venting;* (4) *prevention of blowholes, spongy castings and pitting.*

(1) Copper 34.00 per cent; alloy of copper 50, nickel 50 (half and half) 30.00 per cent; alloy of 10 per cent aluminum bronze, 1.00 per cent; zinc 35.00 per cent.

(2) For small castings, pour when the metal gently *smokes* as the aluminum will cause it to run fluidly. The color should be cherry with breaking of zinc smoke around sides of crucible. Pour heavy castings when the metal has ceased to flare.

(3) Run the metal from the lowest point, and see that it enters the mold gently, without agitation to keep away from dross formation. Use shrink balls on the gates near the castings to avoid *shrink holes* in the casting after the gates have been cut off. Use small sprues that can be kept filled while pouring the molds, and feed thick sections through blind risers and shrink balls. Dry, or skin-dry the molds and pour them vertically whenever possible, through the end holes of the flasks. Vent more than is usual for brass, and take off joint vents from the casting cavities the same as is done for yellow brass. Have all shrinkage balls and feeding runners at a point higher than the castings, and use the same methods in molding as for yellow brass, minus aluminum.

(4) The aluminum prevents blow holes, but if trouble develops add to the alloy in the furnace 4 ounces per hundred pounds of a 10 per cent magnesium copper. Use a free venting molding sand to avoid pitting and spongy castings.

Brass Pressure Castings

We are expected to make brass castings to withstand 90 pounds air pressure, but have trouble getting them tight. We desire to obtain a good formula for such work, and desire to know if a small amount of phosphorus could be added with advantage?

The following alloy will be found suitable for the class of castings mentioned. It is one of three formulas given by S. D. Sleeth in a paper presented before the Institute of Metals at the tenth annual meeting held at Cleveland, O., Sept. 11 to 15, 1916, and now embodied in Volume X of the Transactions of the American Institute of Metals, pages 63-65. The formula follows: Copper, 82.00 per cent; tin, 7.50 per cent; zinc, 4.75 per cent, and lead, 5.75 per cent. The paper also emphasizes the importance of pouring temperature. The alloy must not be cool, neither must it be hot, a medium temperature should be used. Also it is important that it should be aluminum free, as the least trace of this metal will cause leakages. Other impurities that are harmful are antimony and iron, and both should be conspicuous by their absence.

Aluminum Solder Alloys

We would like to obtain a formula for an aluminum solder.

The United States bureau of standards has suggested the following formulas:

Formula Sn. 1-K
Aluminum Solder

	Per cent
Tin	78.00
Zinc	8.00
Aluminum	9.00
Cadmium	5.00

Melting range 194 to 508 degrees Cent.; tensile strength 14,300 pounds per square inch; elongation 18 per cent; reduction 41 per cent.

Formula Sn. 3-K
Aluminum Solder

	Per cent
Tin	84.00
Zinc	9.00
Aluminum	5.00
Phosphor tin	2.00

Melting range 200 to 460 degrees Cent.; tensile strength 11,200 pounds per square inch; elongation 8 per cent; reduction 41 per cent.

Formula Zn. 1-K
Aluminum Solder

	Per cent
Zinc	75.00
Aluminum	5.00
Cadmium	20.00

Melting range 264 to 375 degrees Cent.; tensile strength 28,000 pounds per square inch; elongation nothing; reduction 1.9 per cent.

Phosphor Bronze for Roll Neck Bearings

Several years ago we made a large number of tin, sheet and bar mill roll neck bearings of phosphor bronze and we used to keep the metal standing for some time after withdrawal and to pour the molds when the metal would adhere slightly to a ⅜ or ½ inch iron rod which was fairly hot, the aim being to

cast when the metal would not eat into the sand. The bearings were chunky and were sometimes cast in green sand and sometimes in dry sand molds, but in the case of either kind of mold we often got a sort of liquidation effect on the flat back of the bearing. On the casting made in dry sand, a thin scale which appeared to be high in tin would appear, while in the case of the green sand castings a sort of sunken surface would appear over the thick portions which appeared to set last. The ingot metal was bought from a reputable dealer, but sometimes we used new metals when it became necessary to make our own phosphor tin which was done by tamping a small amount, say half a pound of red amorphous phosphorus in the bottom of a crucible, and then pouring thereon 28 or 30 pounds of molten tin, the pot being put back into the furnace to get rid of the fumes. The alloy we used for the bearings was copper 82.5 per cent; tin 13 per cent; lead 4.5 per cent, which was the original formula as printed in Roberts-Austens book on metallurgy. We would like to know something about the modern practice in regard to these bearings, whether phosphor bronze is still considered the best alloy. Is there anything cheaper that will stand up to mill work? If manganese bronze is any use, is it better to use phosphor tin, or phosphor copper? Which is the simplest method of making phosphor copper? Can bone ash or other material containing phosphorus be used? Last, but not least how may we avoid the difficulties mentioned?

An alloy containing 13 per cent of tin, with or without a small percentage of lead or zinc is hard and brittle and for a bearing has to be perfectly fitted to the shaft. Afterward it must be continuously lubricated. If not well lubricated, it will cut the revolving shaft. The addition of phosphorus still further hardens and embrittles it with the result it may be expected to pound to pieces as the mill is operated. The exudation is known as tin sweat and can be expected in the case of any bronze containing over 10 per cent of tin, and especially if heavily phosphorized. The subject of tin sweat has been dealt with by various writers on nonferrous metallurgy, therefore, can be passed over here with the remark that in the case of high tin alloys, over 10 per cent tin, the tin sweat trouble may be avoided by eliminating phosphorus. In these alloys and especially bell metals, iron is a superior deoxidizer to phosphorus.

For mill bearings of all descriptions, an alloy of copper, 80 per cent; tin, 10 per cent; lead, 10 per cent will be found superior to an alloy containing 13 per cent tin. Some daring spirits insist on putting in even more lead than the above and 15 per cent lead with 10 per cent tin finds favor in some quarters. On the other hand, some founders consider an alloy of 8 per cent tin and 4 per cent lead, with 88 per cent copper to be ideal. It may be, but if 4 per cent lead, why not 10 or 15 per cent? As far as strength when heated goes, the low lead alloys are no better than the high lead alloys if as good.

Hollows on the flat backs of the bearings were caused by shrinkage. Either the feeders were not heavy enough, or both and the pouring heads and feeders were too low, or else some molds were poured considerably cooler than others. With high phosphorus, the metal is so liquid the molds must either be poured cool to get castings, or else the molds must be of dry sand and thickly coated with plumbago wash through which the lively metal will not penetrate. If an alloy like 80-10-10 is used, the maximum amount of phosphorus can be represented by the addition of 0.25 per cent of a phosphor copper containing 15 per cent phosphorus, and such an alloy can be poured hot enough to control the shrinkage on the back of the castings, and should any tin sweat appear it will show on the top of the sprue or risers.

The method of making phosphor tin described is a good one, but it is not necessary for the founder to make his own phosphorized metals as they can be bought at reasonable prices from manufacturers who specialize in their manufacture. We do not advise the use of phosphorus in brass foundries, either to phosphorize alloys, or to make phosphor copper or phosphor tin.

High Conductivity in Copper Castings

We are making high conductivity copper castings for electric welding machines, and we have been requested to make copper disks approximately 6 inches in diameter by 1 inch thick in the center, for the seam welders, and these latter have to be made of as hard copper as possible. The soft, pure copper wears out and pits easily under the arc. We have been fairly successful with the pure copper and will appreciate your suggestions in regard to this hard copper.

The most satisfactory way of hardening this copper according to the experience of some users of electrical welding equipment is to cast it soft and oversize, then forge it down. In this way the copper can be made as hard as a phosphor bronze, or about 90 brinell.

The next best thing is to alloy the copper, which of course, lowers its electrical conductivity and as far as this property is concerned a copper-tin bronze would be just as good. However, some prefer an alloy of copper with 6 per cent zinc and claim it gives every satisfaction though it is not easy to see why. Iron makes an efficient hardener and the copper stays red and looks like copper and that is all for its conductivity has taken flight. Iron can be added to molten copper in any amount from 2 per cent up. It should be added as tin plate loosely coiled, which is submerged and stirred in. To prevent the iron gathering in nodules in the copper, add a minimum of 1 per cent silicon copper, containing 10 per cent silicon.

Troubles Are Avoided by Proper Gating

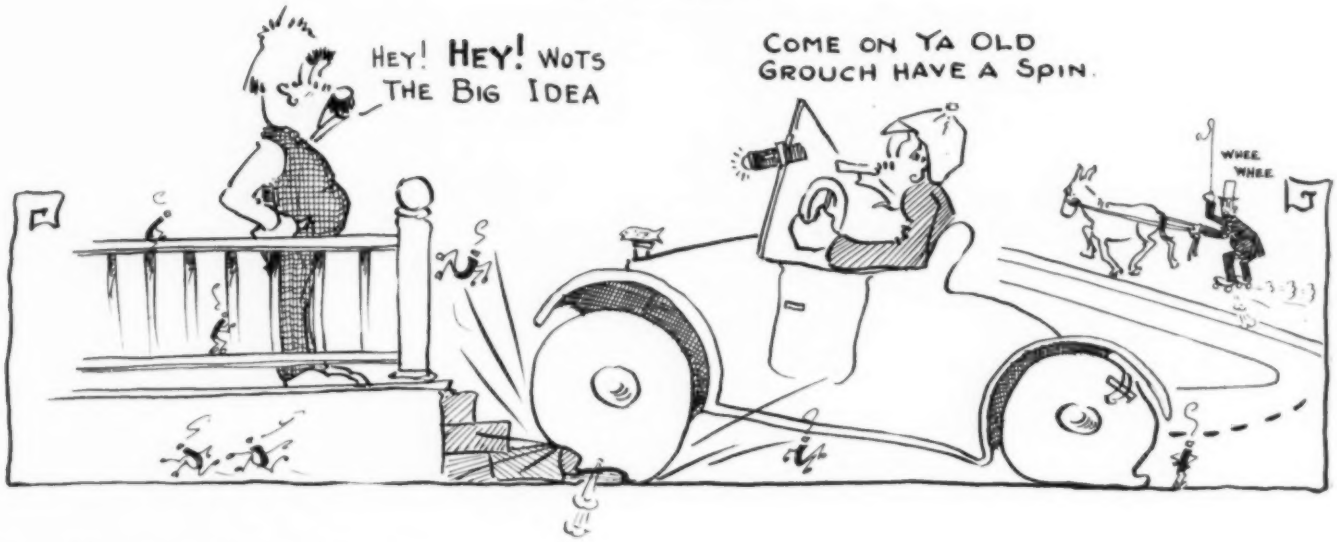
We make quite a few brass castings that shrink on the heavier sections and draw at the gate. We are using ingot metal made from our own 70-30 sheet brass scrap. The ingot metal is melted in a coke-fired furnace, in crucibles holding 54 pounds of metal when filled. We charge each pot with one ingot of yellow brass weighing 30 pounds, then fill with scrap and gates, and add 1¼ pounds of lead and ½ ounce of aluminum, nothing more. What can we add to prevent this porosity at the gates and shrinkage? As a guide we are sending samples cut from the vicinity of the gates.

The holes at the gate are due to shrinkage and are technically known as *draws*. They can be avoided entirely by placing conical shrink balls in the cope close to the casting and on the upper side of the gate to supply metal to feed the shrinkage. A properly placed runner in the cope will also feed the castings. The trouble is due to a lack of knowledge of proper gating methods on the part of the molder. The shrinkage also is due to the same fundamental cause, lack of knowledge about feeding and gating castings. The only way in which knowledge can be conveyed about such matters is by means of clearly written articles illustrated by drawings and diagrams. It may be possible to avoid the shrinkage by increasing the height of the copes, and this should be first tried. The aluminum increases the shrinkage and dirt. With an alloy of 70-30, melted twice, the zinc will be low enough to give a good casting yellow metal without using any aluminum, in fact, if aluminum is used, around 8 per cent additional zinc should be incorporated, both to cheapen the alloy and render it less liable to shrink and draw.

As the alloy stands, if the aluminum is omitted and 1 pound of tin added per pot, the alloy will be better and less liable to shrink. Pour while flaring, and pour strongly, filling the heads and keeping them full.

Bill Sets Bolt Cores in Flanged Pipe

BY PAT DWYER



LAST Sunday afternoon Bill drove up to the door and invited me to go for a spin. Fortunately the front of the house is protected by a few stone steps and a closed door. Otherwise, I believe he would have driven the machine right in, to where I was reclining peacefully with a pipe and a book for company. To be perfectly frank I was not deeply interested in either one and was thinking seriously of flipping a coin—provided I had a coin—to decide whether I should continue smoking until the pipe was emptied, or lay it aside there and then and curl up for a nap. From where I was lying I had a full view of the approach to the door and when I saw Bill's chariot turning in at the curb I realized that I need trouble myself no longer in regard to arriving at a decision on what I should do and what I should not do for the remainder of the afternoon. I did not know what he had in mind, whether he intended to linger for a while or keep on going, but I was reasonably sure if he came in I would have no further opportunity either to read or sleep.

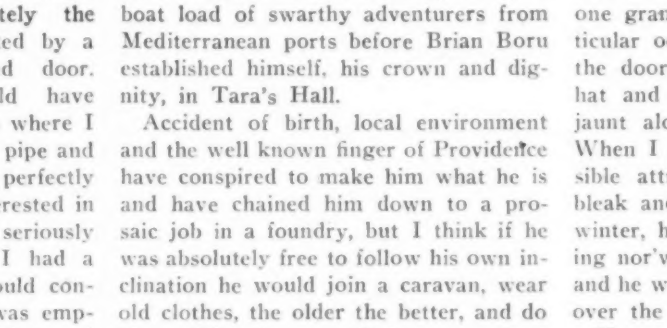
Sometimes, I am inclined to the opinion that he is a lineal descendant of the wandering Jew, or that some of his remote ancestors were members of the original gypsy band that drifted silently down the valley of the Nile and shook the dust of Egypt off its collective feet in the ancient days of the Pharaohs. The fact that he can trace his ancestry in an unbroken line practically back to the time Brian Boru was making them sit up and take notice, does not affect my opinion to the least extent. Ireland was visited by many a boat load of swarthy adventurers from Mediterranean ports before Brian Boru established himself, his crown and dignity, in Tara's Hall.

Accident of birth, local environment and the well known finger of Providence have conspired to make him what he is and have chained him down to a prosaic job in a foundry, but I think if he was absolutely free to follow his own inclination he would join a caravan, wear old clothes, the older the better, and do his cooking in a small iron pot slung over an open air wood fire. He would follow the open road, the long road that knows neither latitude, longitude nor international boundary lines. If he had his way he would view the flaring dawn each day from a new point on the earth's surface and if he could persuade any person to play cards with him all night he never would sleep.

He is one of those aggravating people who never rests and never lets any other person rest. I might be persuaded to forgive him on the first charge, but on the second—well, a man is not clapped into jail for what he thinks and I am one grand little thinker. On this particular occasion he bounced in through the door and insisted that I put on a hat and coat to accompany him in a jaunt along the lake shore boulevard. When I inquired, in dismay, what possible attraction he could find in that bleak and desolate neighborhood in the winter, he said that an all night howling nor'wester had just blown itself out and he wanted to see the waves spouting over the breakwater.

He professed to be deeply grieved to find me idling away my time—vegetating, he called it. He even cast aspersions on my shape and intimated that unless I changed some of my habits, radically, I need not be surprised in the near future to have some young gallus pup refer to me as a turnip.

"You will find yourself," he said, "in a similar position to that of the old lad whose little niece regretted that she no longer could sit on his knee. Pressed for a reason, she complained bitterly that whenever he breathed, she fell off."



KIND WORDS THAT DRIP LIKE HONEY

I might have retorted to the effect that I never had heard of any physician prescribing automobile riding as a reducing exercise, but I knew from long experience that starting an argument with Bill with the object of stopping him, was just about as sensible a piece of work as spraying oil on a flame for the purpose of extinguishing it. I wriggled myself into a hat and coat and said "Let's go." We went. We drove down to the park and stopped in a sheltered place on the bluff above the

deserted bathing beach and in full view of the dripping breakwater in the distance. I don't know how the spectacle would impress an inland dweller, but to Bill and me, raised in a seaport town where the long green Atlantic rollers, with a momentum gained over 2000 trackless miles, smash themselves into cascades of spray against the cliffs at the harbor entrance, the sight was the source of the keenest delight.

"Look at the waves!" said Bill. "There is one of the greatest exhibitions ever staged and yet out of a total of 1,000,000 people living in this town I doubt if one hundredth of one per cent are sufficiently interested to look at it. They are vaguely aware that the water for their coffee and their bath is drawn in some mysterious manner from the lake, but at that point their interest ceases."

"I'd like to know," I said, "where you picked up that hundredth of one per cent language. To me it sounds suspiciously like machine shop talk. I have no objection to listening while these micrometer lads discuss tolerances of a few ten thousandths of an inch, but when a molder starts using terms of that kind I think it is high time to call a halt. The average molder with his grimy little 2-foot rule looks upon the ⅛-inch gradations—when visible—as so much wasted effort on the part of the rule maker. He is familiar with the inches, the halves and, at a pinch, the quarters. Anything less than ¼ inch is known under the inclusive term, a hair.

"Indeed under certain circumstances the term a hair is rendered elastic. For example, the crane comes along with a big core and the craneman starts lowering it in an approximately straight line for the center of the core print. Just before it enters the print the molder discovers that it is anywhere from ⅛ to 1 inch out of the way and immediately shouts to the craneman to 'Move her a hair' in a specified direction. The skillful craneman snaps his bridge control lever or his rack control lever once or twice and moves the core the required hair. How he does it is something that always has excited by unstinted admiration. I worked under a 75-ton crane at one time and the operator could adjust his ponderous bridge and rack to within ⅛ inch of any desired position. He could manipulate his auxiliary hoist to draw a pattern as slowly and gently as any man could draw a smaller pattern by hand."

"Well." said Bill, "Ill tell you. While it is true that the molder as a general rule does not find it necessary to work to such close dimensions as a patternmaker or a machinist, still when you consider all the varying factors with which he has to contend, I maintain that he turns out a great deal of creditable work. I am not referring to automobile or other specialized lines of castings where every component part of the mold and core is jigged and gaged to minute fractional parts of an inch. That branch of the foundry business has been raised to a high state of perfection and in many respects compares favorably with machine shop practice. What I specifically have in mind is the foundry where all kinds of miscellaneous castings are made under ordinary jobbing conditions and where a man might work for a year and never make the same job twice.

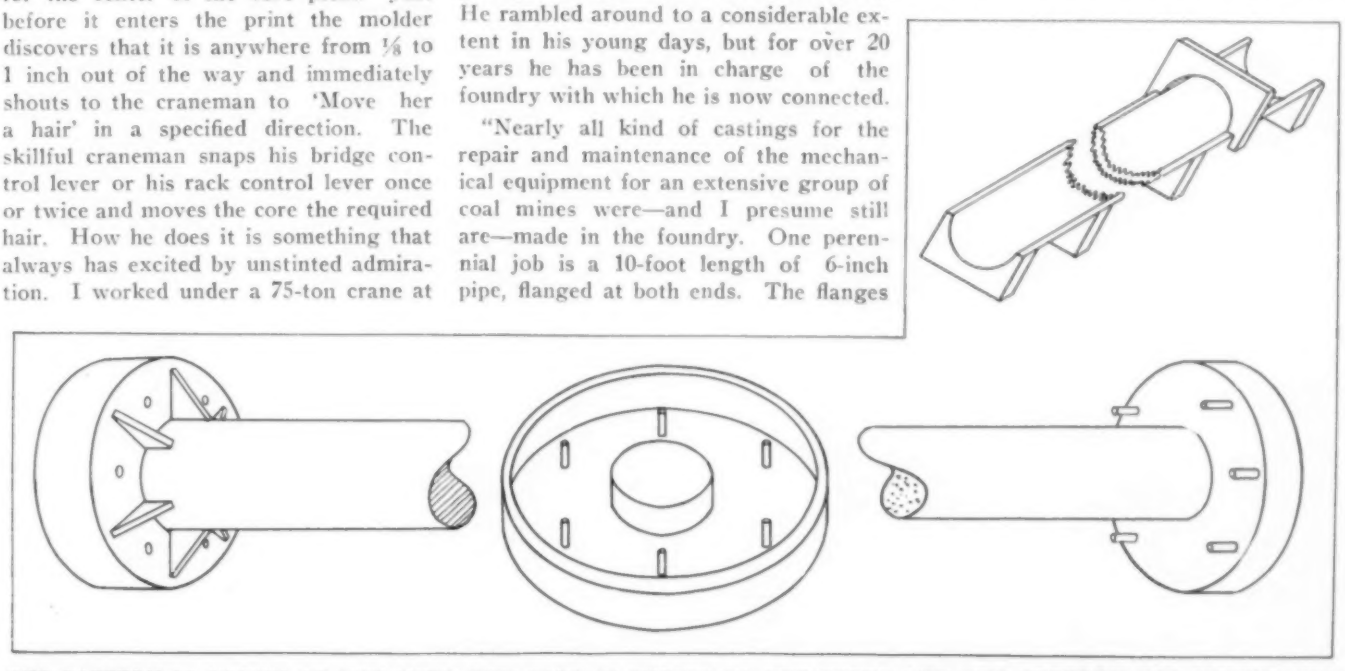
"By a curious coincidence, this wild expanse of stormy water reminds me of an old friend who developed an improved method for molding flanged pipe. If he was here he would consider it a pleasure to dive from the end of the pier and swim out to the breakwater and back. Hardy? Oh boy! Bernarr McFadden has nothing on him. He is well over 60, but he is one of the leading lights in his local gymnasium and the only time he misses his daily dip in the Atlantic is when a driving nor'east gale jams the harbor full of drift ice. He rambled around to a considerable extent in his young days, but for over 20 years he has been in charge of the foundry with which he is now connected.

"Nearly all kind of castings for the repair and maintenance of the mechanical equipment for an extensive group of coal mines were—and I presume still are—made in the foundry. One perennial job is a 10-foot length of 6-inch pipe, flanged at both ends. The flanges are reinforced with six brackets on the inner side and are provided with six bolt holes for bolting the pipe sections to each other. These long pipe lines form part of the pumping equipment employed in keeping the pits free from water. In the natural course of events the workings constantly are driven further under ground and as a consequence a steady supply of new pipe sections is required.

"Nearly all kinds of castings for the the manner practiced almost universally in jobbing foundries. The pattern was split longitudinally through the center and each half was provided with its own complement of brackets and bolt core prints. The bracket at the joint on each side was split in the center to meet the fussy patternmaker's idea of propriety. The entire bracket might have been attached to the drag half of the pattern without adversely affecting the usefulness of the pipe. Tail core prints were attached to the outside of each flange and both prints and brackets, with the exception of the top center print and the joint brackets, were held in place by wire nails until the pattern was surrounded with sand. Then they were tucked firmly in place and the nails were removed.

"Theoretically, this method of providing receptacles for the cores seems satisfactory. However, in actual practice it always does not work out in that manner. It is too easily subject to error. So long as the wire nails remain in the prints, they cannot shift, but after the nails are removed the least carelessness or lack of skill on the part of the operator will result in a shifted print.

"It was even so in this case and com-



THE PATTERN IS SHOWN TO THE LEFT, THE CORE IS SHOWN TO THE RIGHT AND THE COREBOX FOR MAKING THE RING CORE IS SHOWN IN THE CENTER THEY ARE NOT DRAWN TO SCALE

plaints came in from the maintenance gang concerning the difficulty of bolting some of the pipes together. Occasionally a cope was closed with a *shift* and as a result the bolt holes on the cope half of the casting would not appear on the same bolt circle as those on the drag half. Finally a method was adopted which simplified the job in many respects and also insured that the bolt holes would be straight, accurately spaced and on a true bolt circle. The actual time involved in making the mold remained about the same, because the time saved on the green sand floor was taken up in the core room. The greatest saving was effected outside the foundry where the pipes were assembled with a minimum of time and effort. Another feature that proved advantageous occasionally was that the job could be handled by men less highly skilled than those considered necessary with the original pattern.

"A common source of trouble on pipes molded horizontally can be traced to sand forming the core print on the outside of the flange. If the core is a trifle over size the green sand will crush. If the print is unduly *shaved* to prevent such a contingency, one of three things is bound to result to the detriment of the casting. If the end of the flask is not stopped carefully the iron will run out. If the end *is* stopped, a heavy and unsightly fin will have to be chipped from the end of the casting. In his zeal and anxiety to prevent a runout, the molder frequently tucks the sand too tightly and crushes the sand into the flange. Two of the foregoing features will produce scrap castings. The third involves a considerable loss of time in the chipping room. All three were automaticaly eliminated by the method adopted.

"In the belief that the anticipated saving justified the expense, a new pattern was made with the necessary changes embodied in the construction. The old pattern might have been changed, but it had seen considerable hard service and was pock marked all over with the vent wire. For some time the gaffer had been convinced there was no necessity of venting the mold with a wire, but you know how a habit becomes established in a shop and how hard it is to persuade men that a certain routine procedure is not necessary. He decided that the moral effect of a clean, new pattern would be of great assistance.

Description of New Pattern

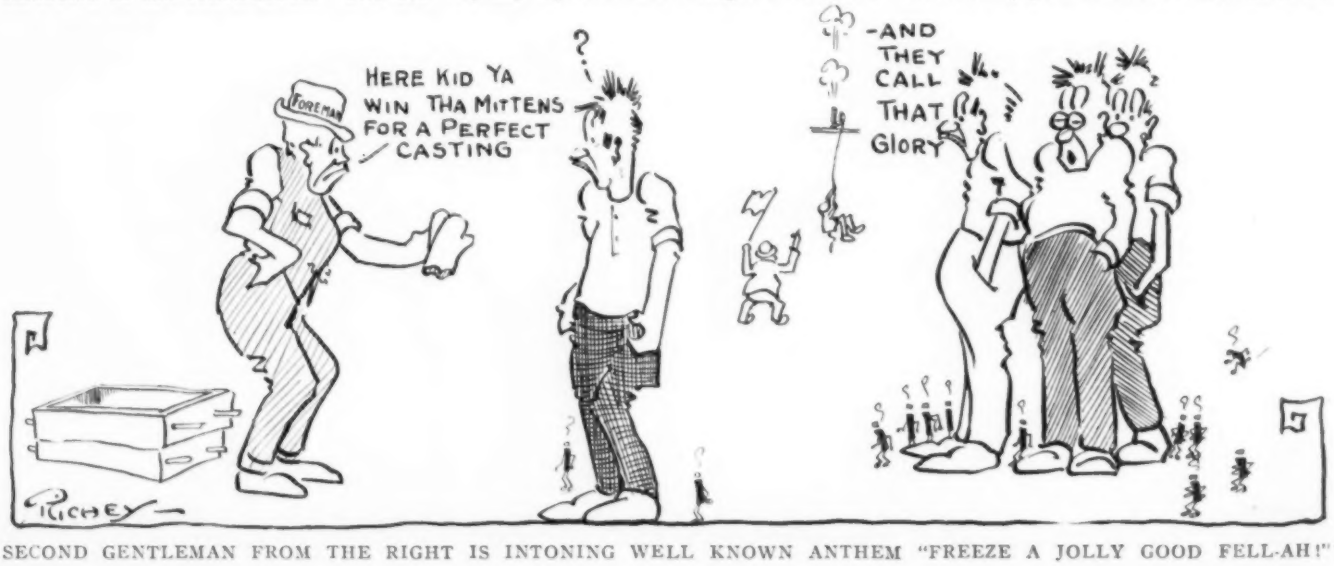
"The position of the brackets was changed on the new pattern so that one bracket remained permanently in the center, top and bottom, and two brackets were held temporarily in place with wire nails as formerly. They easily were tucked in place and even if they did shift a trifle the usefulness of the pipe was not affected. The principal change consisted in adding an extra 3 inches to the thickness of the flange and providing no further core print. A ring corebox was made containing prints for the bolt cores and this ring core also served for a core print in supporting the end of the long pipe core.

"If the castings had been ordered in large quantities, it is probable that either loam or green sand cores swept on barrels would have been used. Under the circumstances where two or three castings a day was sufficient to meet requirements, ordinary dry sand cores were employed. Formerly the core was made in halves and dried and afterward the two halves were pasted and wired together. The time on this item was reduced considerably in connection with the new pattern by making the entire core in an iron corebox and drying it as a unit.

"The corebox pattern was made by nailing ½-inch strips, 1 inch wide, 10 feet 6 inches long, on to five brackets equally spaced and designed to serve as supports for the long half barrel. It was molded concave side down and the sand was slicked and brushed with plumbago to insure a clean, smooth surface. Three boxes were made in this manner. In addition to providing cores for the regular flanged pipes, the coreboxes frequently were utilized for making other 6-inch cores of various lengths.

"In making the core, sand was rammed to a thickness of approximately 1½ inches around the inside of the corebox, then a long piece of 3½-inch steel pipe provided with numerous small vent holes, was bedded in place in the center and additional sand rammed around it and over it. After a sufficient quantity had been rammed in this manner a sweep or strike, with a semicircular 6-inch gap, was employed to remove the surplus sand from the upper side and leave a mound of sand corresponding to a half core projecting above the corebox. The strike was provided with a shoulder at each extremity which served to guide it along the side of the iron corebox. The core was dried in the box.

"The bolt core prints in the ring corebox were made 2 inches long, the flange of the casting was 1½ inches and the bolt cores were made in a gang corebox 3½ inches deep. The bolt cores were pasted into the ring and in that manner were held straight and true. A ring core was slipped on to each end of the long core before the latter was lowered into the mold. It was adjusted in such a manner that one bolt core center was opposite the parting line of the mold on each side of the flange. This arrangement insured that each core on the circle occupied the space in the center between two brackets on the inner side of the flange. The long core was held in place by the ring cores at the ends, one chaplet on the bottom and two chaplets on the top. The flask was a few inches longer than the core. A piece of 3-inch pipe was shoved into each end



SECOND GENTLEMAN FROM THE RIGHT IS INTONING WELL KNOWN ANTHEM "FREEZE A JOLLY GOOD FELL-AH!"

of the core to provide a vent passage and then the space between the end of the core and the flask was rammed full of sand."

"After that," I said, "I suppose they never had any more trouble. Every casting was perfect. The machine shop foreman probably paid a formal call every Monday morning and presented a bouquet and a pair of white gloves to indicate that another week had gone by, pure and undefiled. The general manager dipped the flag three times in the direction of the foundry on the first of every month and the chief engineer at the power house cut the siren loose for three trimuphant blasts every time he was notified the bottom dropped."

"Yes," said Bill, "and maybe pigs have wings. Any old time a foundryman makes a perfect or nearly perfect score, all he draws is a hard look. If he hears any comment it is in the shape of an interrogation. His latest achievement is held up to prove a perfect score is possible and then he is asked to explain why he formerly fell short in his efforts."

Notes Effects of Uranium on Cast Iron

URANIUM, one of the most active elements, has a strong affinity for both oxygen and nitrogen. The heat of the reactions that are incident to the introduction of ferrouranium into cast iron raises the temperature of the metal.

The most important features of uranium in this connection are its effectiveness as a scavenger and its influence on the size and distribution of the graphite. The strength of cast iron depends in a great measure upon the size of the graphite flakes. As graphite is not a chemical component of the metallic body, but is only mechanically mingled with it, the smaller the size of the graphite flakes, the smaller will be the planes of weakness. This point is aptly illustrated by malleable cast iron, which may have a tensile strength of 45,000 pounds per square inch, even when the graphitic or temper carbon is as high as 3 per cent. The scavenging action of uranium tends to improve the quality of cast iron by making it clean and dense in grain. Uranium iron is being used in glass bottle molds, and in blanks and plungers in bottle machines.

In applying uranium to cast iron, it must be remembered that the temperature of the iron is much lower than that of molten steel; consequently, one should use the ferroalloy crushed to a fineness of about pea size. Where the iron is melted in a cupola, it is necessary to add the alloy in the ladle, or in the spout. As the amount of heat available for dissolving the ferroalloy is limited the iron should be tapped as hot as possible, and the ladle which is used should be heated. After the bottom of the ladle is covered with a few inches of iron, the crushed ferrouranium is added by sprinkling it upon the surface of the metal in the ladle or in the spout. In this way advantage is taken of all available heat, and also the mixing effect of the stream. After the alloy is added, the contents of the ladle should be stirred well, to insure thorough incorporation and complete reaction. It has been found that the addition of 0.10 to 0.20 per cent uranium is all that ordinarily should be attempted.

The author, Hugh S. Foote, is metallurgical engineer, the Standard Chemical Co., Pittsburgh, miners of uranium and vanadium ores.

Air Furnace Iron Hotter

In the case of air furnace, or of higher grade electric furnace iron, with their reserve of available heat, the ferroalloy need not be as fine as is recommended in cupola practice, and is added in the ladle or in the spout. The addition of 0.18 to 0.20 per cent uranium is recommended.

Tests were made in the foundries and laboratories of the Carnegie Institute of Technology. The results shown in the accompanying tables were reported by William H. Dosey, head instructor of foundry practice in the institute, who says in his report:

"The method used to introduce the alloy into the molten metal was to add it in the ladle as the iron was being tapped from the cupola. Breaking the alloy into pea-size pieces and giving the metal a vigorous stirring before pouring in the molds is to be recommended. This insures a more thorough amalgamation with the molten mass, and prevents the alloy from sinking to the bottom of the ladle and remaining there inactive. Care was taken to pour the specimens for the different tests with iron of equal temperature and then leaving them in the molds until absolutely cold.

"The transverse test bars were made 1¼ inches in diameter by 15 inches long, in dry sand cores and poured on end. They were tested 12 inches between supports, applying the load in the center. Each result is the average of six bars tested. The tensile test bars were made of the same shape as the bars for the transverse test and machined down to 0.80-inch diameter through the test section. They were molded in green sand and poured on end. Each result is the average of two bars tested.

"The method adopted for the wearing test was as follows: Two pieces were cast from No. I and No. II iron, measuring 9⅞ inches long, 1⅞ inches wide, and 1 inch thick. These were machined to a smooth surface on all sides. The pieces were placed in a machine and allowed to rub against each other for a period of 80 hours. A weight of 20 pounds was applied to the specimens. The specimen from No. I iron lost 0.290 grams, while that from No. II iron lost only 0.250 grams.

"A fluidity test, made with patterns 3 inches wide, 14 inches long, and ½ inch thick on one end and running to a feather edge on the other end, showed that the alloy has no detrimental effect on the fluidity of the iron, but rather added, through some reaction plainly noticeable in the molten metal,

TABLE I

Tests Showing Effects of Additions of Uranium to Cast Iron

	Uranium Added Per cent	Uranium Found Per cent	Combined Carbon Per cent	Graphitic Carbon Per cent	Total Carbon Per cent	Silicon Per cent	Manganese Per cent	Sulphur Per cent	Phosphorus Per cent	Transverse strength	Tensile strength lbs per square inch
I	None	None	0.71	2.59	3.30	1.67	0.32	0.113	0.563	3413	27,886
II	0.10	0.07	0.74	2.56	3.30	1.68	0.30	0.101	0.534	3768	30,795
III	0.20	0.18	0.62	2.70	3.32	1.70	0.32	0.092	0.550	3882	30,765
IV	0.30	0.21	0.66	2.70	3.36	1.77	0.36	0.090	0.524	3743	30,765
V	0.40	0.22	0.69	2.67	3.36	1.75	0.31	0.074	0.540	3758	29,920
VI	0.50	0.26	0.65	2.67	3.32	1.72	0.27	0.081	0.564	3722	31,113

to its qualities for making clean, sharp, light castings.

"Specimens of chill blocks, ½ x 2½ x 4 inches, were poured on cast iron plates 2 inches thick. Fractures and figures of the brinell test for hardness of specimens poured in sand molds show little change in hardness and chill over iron without alloy, whereas in the specimens poured on chill plates, a considerable increase in the ability to take chill is noticeable. The results of the hardness tests are shown in Table II.

"Microphotographs and chemical analysis show that no change in the composition of the iron has taken place, but a breaking up of the larger graphitic flakes is prominently shown. This closer grained and homogeneous metal is indicated by the micrographs in the accompanying illustration."

Table II

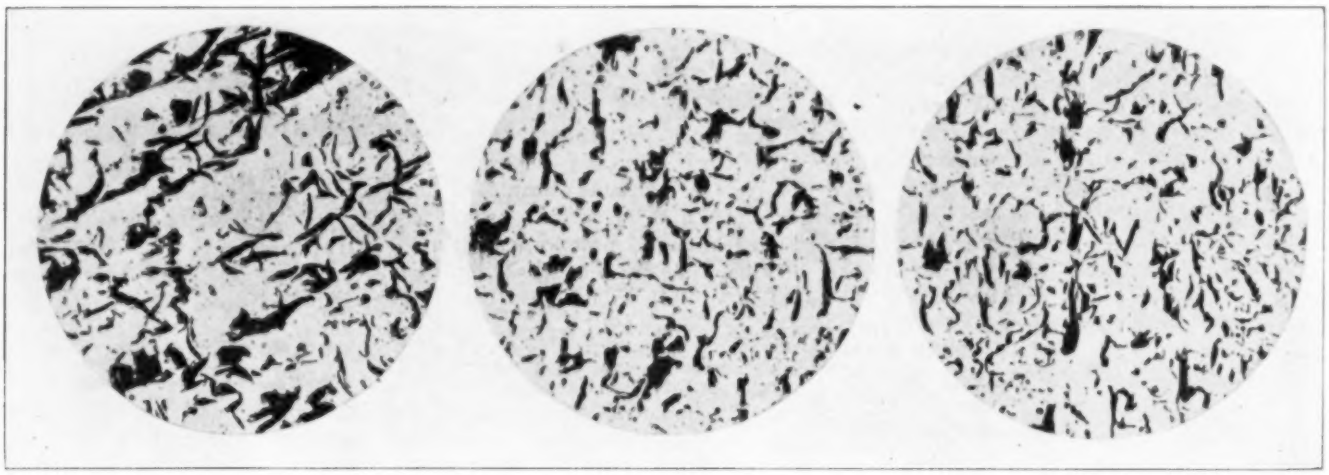
Brinell Hardness Test

Sample No.	Brinell Numbers Chilled specimens	Unchilled specimens
I	262	187
II	477	187
III	418	196
IV	418	187
V	418	196
VI	387	196

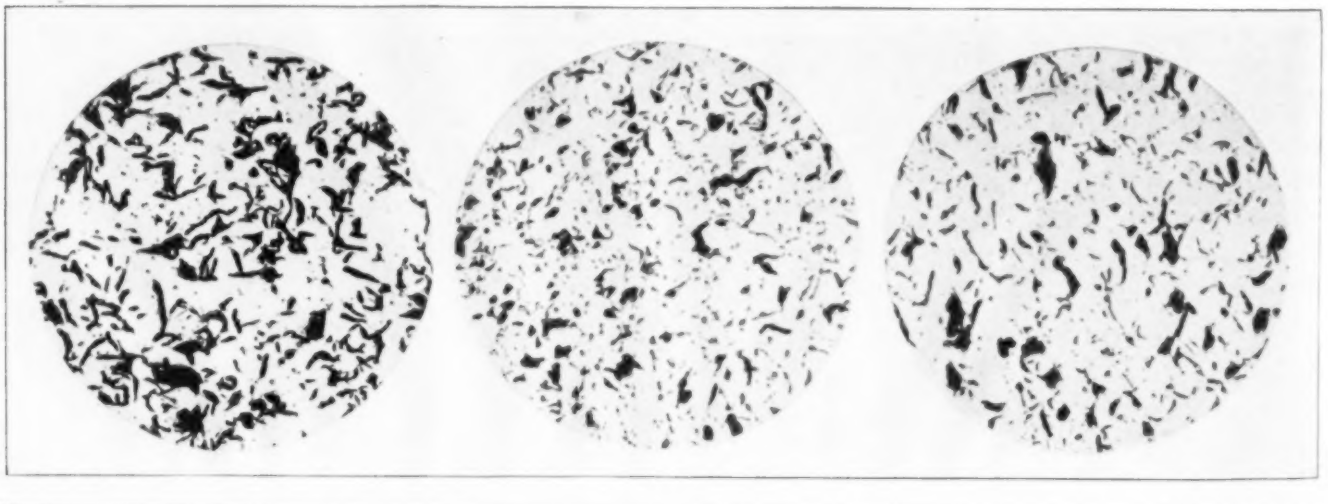
Announce Changes

Announcement of a number of changes in its active sales force has just been made by the W. W. Sly Mfg. Co., Cleveland. In the Chicago office, the present district manager, C. P. Guion, will be assisted by Ralph O. Mullen. Mr. Mullen has been connected with the home office of the organization for a number of years. Due to the increase of business in the Cleveland district covering Ohio, West Virginia and the western half of New York and Pennsylvania, E. T. Williams has been added to the present staff consisting of L. B. Brewster, district sales manager, and H. C. Nicholas, sales engineer. Mr. Williams has had a wide experience in foundry practice in both the practical and sales ends. D. P. Carter, eastern district manager, located at New York, will be assisted by H. P. Furlong. Mr. Furlong has been connected with the foundry industry for about 15 years and has a wide acquaintanceship among American foundrymen particularly in the East. On the Pacific coast, the company is now represented by H. R. Atwater, formerly sales manager of the Osborn Co., Cleveland. He will be located at 1407 Detroit street, Hollywood, Cal. To serve the foundries of the Gulf region to better advantage, the Sly company has secured the services of the P. H. McArdle Equipment Co., New Orleans, as representative for Texas, Louisiana, Mississippi and Florida.

The American Manganese Steel Co., Chicago, will be represented in Utah and eastern Nevada by Landes & Co., Salt Lake City, in New Mexico and Arizona by Herbert B. Wolcott Jr., El Paso, Texas, and in Colorado by the A. T. Herr Supply Co., Denver.



Micrographs taken from the center of the cross section of 1¼-inch diameter transverse test bars cast in a dry-sand mold—All unetched and magnified 50 diameters—No. 1 contained no uranium—0.10 per cent uranium was added to No. 2; 0.20 per cent to No. 3; 0.30 per cent to No. 4; 0.40 per cent to No. 5; and 0.50 per cent to No. 6



Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

SPECIFICATIONS FOR WELDING ELECTRODES

General

The following specifications prefixed by the letter E are recommended for the purchase of all bare iron and steel electrodes for use in arc welding. The use of each particular type of electrode is specified below.

Scope

The electrodes herein specified are recommended as covering the usual railroad, shipyard and industrial requirements as are allowed by authoritative regulating bodies, such as the American bureau of shipping, the interstate commerce commission, etc.

Material

Material made by the puddling process is not permitted.

Physical Properties

Electrodes shall be made of commercially straight wire of uniform homogeneous structure, free from irregularities in surface hardness, segregation, oxides, pipe, seams, etc. Diameter shall not vary more than plus or minus 3 per cent from diameter specified.

Nomenclature

The prefix letter E is to indicate that the material is intended for electric arc welding.

Chemical Composition

The chemical composition of electrodes shall be within the following limits for uses specified:

Standard Specifications of the American Welding Society

(*Continued on Data Sheet No.* 512)

SPECIFICATIONS FOR WELDING ELECTRODES

(*Continued from Data Sheet No.* 511)

Low Carbon Iron or Steel

E-No. 1A

	Per Cent
Carbon	not over 0.06
Manganese	not over 0.15
Phosphorus	not over 0.04
Sulphur	not over 0.04
Silicon	not over 0.08

E-No. 1B

	Per Cent
Carbon	0.13—0.18
Manganese	0.40—0.60
Phosphorus	not over 0.04
Sulphur	not over 0.04
Silicon	not over 0.06

The difference between E-No. 1A and E-No. 1B electrodes is one of chemical composition incident to manufacture only. In order to assure uniformity of product close limits are demanded. Either E-No. 1A or E-No. 1B may be supplied unless the purchaser, in ordering, specifically excludes either.

Medium Carbon Steel

The data at hand shows that bare steel electrodes having a carbon content of 0.18 to 0.85 per cent are of no particular value.

High Carbon Steel

E-No. 1C

	Per Cent
Carbon	0.85—1.10
Manganese	0.30—0.60
Phosphorus	not over 0.04
Sulphur	not over 0.04

(*Continued on Data Sheet No.* 513)

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June 4, 1923.

The Foundry,
Cleveland, Ohio.

Attention: Mr. J. D. Pease,
Director Advertising Sales.

Gentlemen:

We are just in receipt of your favor of May 23, asking if we had had satisfactory returns from our advertising in THE FOUNDRY.

We are pleased to advise that we regard THE FOUNDRY very highly as an advertising medium to reach the buyers of foundry equipment, in fact there is no other publication that so thoroughly covers the foundry field.

It is not so long ago that we doubled our space with THE FOUNDRY feeling that the additional expense was justified in view of the new business we had obtained through your publication.

Trusting that the above statement covers the information you desire, we are

Yours very truly,

THE CLEVELAND PNEUMATIC TOOL CO.

H. S. Covey

HSC/RSA

Secretary.

Melts Electric Furnace Iron

Basic Lining Allows a High Degree of Refinement and Superheat Insures a Metal Comparatively Free from Occluded Gases—Lowering of the Sulphur Content Advocated

BY GEORGE K. ELLIOTT

THE first use of the electric furnace for gray cast iron in every day production, and not in sporadic experimental heats, seems to have been in the iron foundry of the Lunkenheimer Co. at Cincinnati, in the summer of 1917. Beginning with cold charge heats the process soon underwent a logical change into the duplexing process, wherein the cupola was utilized for the otherwise costly melting period of the cycle.

It is the writer's understanding that several foundries are using the cold-charge method regularly where tonnage is too small to justify a cupola, and close control of an exceptional grade of iron is required. Under such combination of circumstances there seems to exist a limited economical field for the complete cycle of melting, refining and superheating in the electric furnace.

Several furnaces using the cold charge are operating with acid hearth, which means leaving from the cycle the element of refining except in a sense that is mild in comparison with the rigorous basic process. Properly conducted this acid process consists of melting and superheating under conditions that at least are nonoxidizing as far as furnace atmosphere is concerned. The length of time the metal is kept in the furnace after being melted may become a period of purification in so much as an undisturbed exposure to a high temperature in a harmless atmosphere is liable to bring about a flotation on the bath of some of its nonmetallic inclusions. Especially will high sulphur aided by manganese automatiaclly be reduced in this way to a measurable degree. Irons with 0.15 per cent sulphur have been known to decrease by as much as one-fourth or one-third through manganese sulphide floating to the surface.

Duplexing Process to Lead

The cold-charge process for cast iron probably never will acquire more than a scattered application, and the greatest possibilities seem to lie with the duplexing process. This is because the cupola cannot be relegated to disuse without working economic violence to the commercial foundry. The cupola delivers molten iron, with a minimum of care and labor, too cheaply to be discarded. It needs no substitute but at times an adjunct is desirable; here is the opportunity for the electric furnace.

Since the duplexing process apportions refining to the electric furnace the most logical hearth for the electric furnace is the most potently refining one, in other words, the basic hearth. In it lie the best and widest possibilities of the electric furnace for cast iron.

Duplexing as said before probably was practiced first at the Cincinnati plant, while it was at a plant in Birmingham, Ala., that it developed its greatest tonnage. This was in a pipe foundry where frequently over 200 tons of iron was passed through the electric furnace in 24 hours.

Electric Furnace Warranted

What are the conditions in the average iron foundry of today that make feasible the addition of an electric furnace to the equipment? In a sentence we can answer that the influencing factors are, the limitations of the cupola, the cost of available raw materials, and a shifting of the basis of competition in a certain volume of the gray-iron castings business from price per pound to quality per piece. Any one of these may carry enough weight to swing the balance in favor of the electric furnace in some cases. But in the great majority of foundries the three united cannot budge the cupola from its present established position. The electric furnace must not be taken up hastily and without a complete survey of its advantages and disadvantages, because in one field it may be an unmistakable success while in another it will show only loss.

In speaking of the limitations of the cupola the writer must not be taken as unfriendly to it or in the least unappreciative of its many advantages. It is without peer as an efficient, inexpensive, universally operated metallurgical servant for the production of molten iron. Probably no other furnace can melt similar metal at a fuel cost of 75 cents or less per ton, which is what the cupola does steadily and with approximate satisfaction on all counts. It lacks only some of the refinements of operation frequently demanded by modern conditions. These improvements are an ability to reproduce uniformly any desired composition of iron, a positive ability to refine in addition to melting, and an increased power to superheat. To accomplish refining the cupola is helpless while it has decided restrictions when it comes to superheating.

Electric Furnace Superheats

Just as the inability to refine and superheat are outstanding weaknesses of the cupola, so is the corresponding ability to do them the great advantage of the electric furnace, especially the furnace with basic bottom. Such a furnace is the pre-eminent refining furnace for iron and steel. Handling cast iron, it is capable of delivering without too great attention metal superheated to any degree, reduced in sulphur as required, deoxidized, and with carbon, silicon and manganese adjusted to the desired standards. Phosphorus alone cannot be altered in cast iron by the electric furnace except by impracticable methods.

The electric furnace is at its best when coupled with a chemical laboratory in an intimate manner. By sampling the molten iron as soon as it is transferred from the cupola the laboratory can determine as many elements as desired, and the proper additions can be made before the metal is ready to pour, making possible the closest regulation of the composition. Especially is this valuable in regulating silicon and carbon, elements reflected in the machinability of the castings. The rapidly growing tendency in machine shops to introduce standardized rates of machining seems to be taking little or no heed of the fact that there are many kinds of cast iron, and that more than one kind may come from one foundry in one cupola during one day.

Maintaining fixed rates of machining and high production cannot be divorced from preserving the proper grade of iron in the castings. In order to keep uni-

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Paper presented at the general meeting of the American Electrochemical society, held in Baltimore. The author is chief metallurgist, the Lunkenheimer Co., Cincinnati.

formly a certain machinability, iron must not vary in composition over too wide a range, especially in silicon and carbon, and at times manganese. Not a few factories have installed ultramodern castings-finishing methods without first co-ordinating in the proper way their metallurgical and mechanical operations. In such cases the results are liable to be either a sad falling down in production from what was so elaborately planned, or a sacrifice of highly desirable physical properties in the product in order to attain and preserve production. Planning production without first establishing the best grade of iron for the product has led to more than one manufacturing debacle. The combination of laboratory and electric furnace can be made to work nicely in solving problems of this order.

Higher Sulphur in Scrap Pile

The most striking reaction taking place in the basic electric furnace is desulphurization; also it may become its most valuable. There is no gainsaying that there is a tendency towards higher sulphur in the world's scrap pile. This is not because the foundrymen are no longer afraid of it and are giving it free rein, but rather because it daily is becoming more difficult to hold it within bounds. The universal scrap pile is swollen with the grim harvest of the greatest of wars, and economy demands that it be worked over into usable implements fit for the pursuits of peace. The average of the sulphur is high, perhaps 0.15 per cent, and upon remelting in the cupola almost 0.03 per cent more is picked up with each remelt. The basic-hearth electric furnace seems created almost for this crisis. Elimination of sulphur by its means is one of the readiest of metallurgical operations. Cast iron having 0.18 per cent sulphur can be reduced to under 0.07 per cent in about thirty minutes, meaning the changing of relatively bad iron into good metal. Geographical considerations are strong here, and the foundry located in a region remote from the sources of good pig iron, and therefore having to reply upon the scrap pile of the neighborhood, may be in a logical position to consider seriously the basic-hearth electric furnace.

The introduction of the basic-hearth electric furnace is largely responsible for the prominence that the subject of sulphur in cast iron has received in recent years. The time is approaching rapidly when the question of the real effect of various amounts of sulphur in cast iron must be systematically and authoritatively investigated. Something is needed to reconcile the apparently anomalous results with high and low sulphur irons that are reported from time to time by different foundrymen and metallurgists. Logical sponsors for such inquiry would seem to be either the American Society for Testing Materials or the American Foundrymen's association, or a committee of the two organizations.

The conditions in cast iron that will conduce to the precipitation of sulphide, in particles of an optimum size and of an optimum degree of dispersion, so as to assist or at least not hinder the production of mechanical properties of a high order, is a subject about which we know practically nothing. In conducting a research along this line we can suggest a promising means of attack in the recent announced slip interference theory of the hardening of metals by Jeffries and Archer,* which seems capable of a wide application to many of our metallurgical problems, including the one of sulphur in iron. The question of mechanical tests also is involved in the solution of the sulphur problem, and it seems advisable that increased attention be given to tests of a more dynamic nature than the customary transverse and tensile tests, because there is good reason for believing that tests of such nature will differentiate between irons that give nearly identical results under the mentioned static tests.

If an answer to the sulphur problem ever is found, it probably will be many fold with different limits of sulphur for different kinds of castings. The writer has first-hand knowledge of one class of large castings that invariably are *dirty*, to quote the foundryman, at an important machined point whenever sulphur reaches 0.10 per cent or over. Empirically in this one case the answer has been found; generally we can only surmise how far we dare go with sulphur.

To the writer it seems that the sulphur question is involved in the greater one of general refinement, and it is probable that iron high in sulphur also is endowed plenteously with other impurities some of which may be almost entirely unknown. Examples are oxygen in various combinations, nitrogen as nitride, and perhaps others even less familiar. The fact that an iron is desulphurized is evidence that it has passed through a strong refining treatment, and the possibility that some of the benefits attributed to low sulphur in reality may be the result of the removal of one or more other impurities along with it, has to be recognized. Desulphurization of iron means one of the most drastic cleansings known to metallurgy and consequently low sulphur is becoming a hallmark of refinement.

Reducing Slag Needed

Removal of sulphur requires a reducing slag and this carries with it additional advantages to the iron. Broadly speaking there are two inflexible requirements to be complied with before desulphurization can take place—a strongly basic slag and complete deoxidation of slag and bath. Without both no elimination of sulphur occurs. The slag is made from an excess of lime with fluorspar added for fusibility, and coke dust to produce the needed reducing conditions. Deoxidation of bath, since manganese, silicon and carbon all are present, perhaps is a somewhat complex reaction, but for simplicity we can assume the probable role of manganese as illustrative. In this case the reaction can be taken as

$$FeO + Mn = MnO + Fe$$

Being not as soluble in molten iron as FeO, the MnO rises to the surface to be taken up by the slag, where it is acted upon by the carbon and reduced back to metallic manganese—

$$MnO + C = Mn + CO$$

the carbon monoxide escaping into the furnace atmosphere. After the last of the oxide has been removed from the slag the first step toward desulphurization begins. Immediately around the electrodes where the greatest temperature prevails the carbon and the lime of the slag react, forming calcium carbide—

$$CaO + 3C = CaC_2 + CO$$

This reaction is assurance that deoxidation is completed. Elimination of sulphur then proceeds by one, or probably both, of the following reactions—

$$\left.\begin{matrix}MnS\\FeS\end{matrix}\right\} + CaO + C = \left.\begin{matrix}Mn\\Fe\end{matrix}\right\} + CaS + CO$$

and

$$\left.\begin{matrix}3MnS\\3FeS\end{matrix}\right\} + 2CaO + CaC_2 = \left.\begin{matrix}3Mn\\3Fe\end{matrix}\right\} + 3CaS + 2CO$$

The calcium sulphide formed in either reaction is insoluble in molten iron, making certain the efficacy of the operation.

Deoxidation is a necessary concomitant of desulphurization, and cast iron coming from this process should be fairly free from oxides. This introduces one of the moot questions of cast iron. By some reputable authorities it is stoutly maintained that molten cast iron contains too much carbon, silicon and manganese to be able to carry iron oxide at the same time. Others declare it is entirely possible, and that its presence has certain tangible effects. As to the nature of the effects again there is a division of opinion. One group claims they are good while another takes the opposite view, roundly condemning oxidized or *oxygenated* iron. The writer inclines to the belief that oxygen often persists in cast iron, in spite of the presence of oxidizable elements that should remove it, and also that its presence is undesirable. It seems to him that the persistence of oxygen as iron oxide in molten iron is as reasonably expected as is the well known persistence of determinable amounts of sulphur and phosphorus in steel heats that have been put through the most rigorous treatments for the removal of these elements. This phenomenon is readily explained by the law

*The Slip Interference Theory of the Hardening of Metals, by Zay Jeffries and R. S. Archer; Chemical and Metallurgical Engineering, 1921, 24, 1057.

of mass action, which enables the iron to hold to the last traces of these impurities.

That the influence of oxygen on the whole is bad, is borne out by many experiences with the product of badly acting or carelessly operated cupolas. In these cases the iron without doubt was exposed to oxidizing conditions, and that it was materially affected thereby was shown in the sluggishness of the melt, which in spite of a high temperature prevented its producing castings solid enough to pass a porosity test. It appears probable that oxygen in some of its combinations, especially iron oxide, raises the freezing point of cast iron, bringing about a practical diminution of fluidity. One other point against iron oxide is its reaction with carbon which is known to produce unsoundness in steel through the resultant gas, and there is reason to hold that this can happen also with cast iron. The time spent in the electric furnace during duplexing gives ample opportunity for this reaction to complete itself. This may be one of the benefits of the process.

New Theory Advanced

A novel and interesting, if not entirely acceptable, conception of cupola iron is presented in a recent article,* in which the theory is advanced that much of the supposedly oxidized iron from the cupola and other furnaces is not suffering from over-oxidation, but from the absorption of aluminum from the refractories, the same forming a carbide which, upon reacting with the moisture of the molds, creates a gas with consequent blow holes in the castings. The article also claims an analogous reaction can take place at electric-furnace temperatures, with the absorption of calcium from the basic slag and the formation of carbide in the metal. Following out this assumption, the claimed benefits of oxygenated iron are traced to the curative effect that oxygen naturally would have upon iron contaminated with carbides. While the present writer has not had the opportunity to investigate this strange theory which presupposes deoxidizing in the cupola, he is not able to make it account for many of the cases of apparently burned iron that he has observed. The evidences of oxidation were too strong and efficacy of deoxidizing measures as a cure were too pronounced, to make readily tenable any speculation that chemically reducing conditions were at the root of the trouble experienced with the iron. However, the possibility of the reaction taking place even infrequently is worth investigation, as also is the one concerning the absorption of calcium by iron in the electric furnace.

The oxygen question of cast iron is bound to remain unsettled as far as universal conviction is concerned, until analytical chemistry rises to the occasion. At present there is no generally accepted adequate method for determining all the oxygen in iron or steel. The Ledebur method is practiced here and there, but admittedly has serious limitations, it being claimed that it reaches at best only 75 per cent of the ferrous oxide that may be present,* while it misses entirely the oxides of manganese, silicon and titanium. Few contributions to metallurgy could at present be greater than a complete set of accurate practicable methods for determining oxygen and oxides in the various metals and alloys. In the same category we may also include nitrogen and other gaseous elements. The arc electric furnace, particularly the long-arc furnace, with its seeming possibilities for nitrogen fixation, makes pertinent the question of determining nitrogen readily and studying its effects upon iron and steel. There are the Allen method, and one or two others, for determining nitrogen but they are attended by an uncertainty similar to that of the Ledebur oxygen method.**

Chemical Analyses Not Complete

We are forced to admit that chemical analyses as now made of metals and alloys often are only part analyses, and the elements that are eluding the analyst may be of paramount practical importance.

In no other furnace can superheating be so effectively done as in the electric furnace. Either the acid or the basic furnace is a good superheater, but the former has some disadvantages in that too high superheat, sometimes, depending considerably upon the quality of the refractories, has a tendency to raise the silicon unduly. Several times the writer has seen as high as 3.80 per cent silicon in cast iron coming from an acid furnace that went in at barely 2.00 per cent. In the basic furnace the tendency is toward a slight reduction.

The advantages of superheating can all be summed up in the one word *fluidity*. The electric furnace gives fluidity to irons not commonly considered fluid, a conspicuous example of which is low-phosphorus iron. This class of irons generally is pre-eminently strong, but unsuited for castings needing fluidity. Superheating in the electric furnace can make many of these irons eligible for the thinnest of sections.

Fluidity is a strong assurance of solid castings through freedom from blow holes, shrink holes, slag inclusions, and the like. Superheated metal increases the effectiveness of risers by lengthening the period of fluidity which is their only period of activity as feeders, and thereby obviates to a large degree that internal shrinkage that comes from fluid contraction of the metal. Abetted by superhot metal the efficiency of the ordinary riser becomes surprising.

Blow Holes Eliminated

Blow holes seem to be eliminated to a considerable extent by superheated metal acting through risers. The ferrostatic pressure of molten iron is nearly one-quarter of a pound per square inch for each inch of head. In any mold of ordinary dimensions this is not great enough to increase perceptibly the density of the metal itself, but it seems sufficient to prevent the release of dissolved gases from the metal and the consequent formation of blow holes. In this way the pressure of fluid molten metal may be said to increase the actual density of the castings themselves by the elimination of blow holes. This tendency of highly fluid iron to prevent by pressure the liberation of dissolved gases perhaps is somewhat unnecessary in the cases of electric furnace irons that have been through sufficient refining to insure practical degasification.

In connection with the gases CO and CO_2 held by the metal in solution or otherwise, there was a significant paper read before the British Iron and Steel institute in the autumn of 1920, by Honda and Murakami, in which it was claimed that in pure iron-carbon alloys graphite is formed not as the direct result of the decomposition of cementite at high temperature according to the reaction, $Fe_3C = 3Fe + C$, but rather through the catalytic action of CO or CO_2. Should this hold true with impure alloys such as cast iron, the removal of these gases in the electric furnace might be expected to have a retarding effect upon the precipitation of graphite.

The writer has seen some evidence to strengthen this theory, chief of which is an occasionally apparent capability of electric-furnace cast iron to carry higher silicon without perceptible opening of the grain, excessive graphitization and the consequent softening and loss of strength than a similar iron is capable of that has not been refined. In other words degasification in so far as the elimination of CO and CO_2 are concerned may explain a part of the increased strength and soundness of electric furnace cast iron, on the ground of its ability to discourage a headlong massive precipitation of graphite. It may be that this retarding influence modifies the form of the graphite as well as influencing finer and more advantageously dispersed particles. This is far from a settled matter.

*W. L. Morrison in THE FOUNDRY, 1922, page 33.

*Bureau of Standards Scientific Paper No. 346, by Cain and Pettijohn.

**Very recently (Chemical and Metallurgical Engineering, 1922, 26, 218) there was published an iodide-iodate method by Hurum and Fay, that may be one of the needed long steps forward in the determination of nitrogen in steel: so far no mention has been made of its applicability to cast iron.

Cleaning Automobile Castings

Heavier Parts, Such as Cylinder Blocks Are Ground by Swing Grinders, While the Light Sections Are Handled on Floor Stands—Inspection Required

BY FRED B. JACOBS

WITH an annual output of 4,500,000 automobiles, to say nothing of tractor and power-boat engines, the production of automotive-engine castings is an important branch of present-day, gray-iron foundry practice. While the actual molding operations pursued in the production of these castings have been highly specialized, considerable attention also has been devoted to cleaning room operations so that the cleaning department of the up-to-date foundry presents many interesting problems. At the plant of the Allyne-Ryan Foundry Co., Cleveland, large numbers of automotive castings such as cylinder blocks, heads, pistons, manifolds, camshaft bearings, etc., are produced daily and the cleaning room operations followed at the present time reflect the results of tests carried on during the war when it was necessary to handle many thousands of castings daily.

After the castings are shaken-out they are delivered to one end of the cleaning department where the cores are removed. This, of course is a manual operation, but through constant practice, the operators become expert in handling various parts such as cylinder blocks and heads. The castings with the cores removed are delivered to the grinding department. The core sand is deposited on a belt conveyor set at an angle. From this conveyor the sand, which contains a large amount of metal, is dropped to another belt. As the material drops it passes a magnetic separator that removes all metal while the sand is conveyed to open freight cars placed on a siding that parallels the cleaning room and is conveyed to a dump.

Cylinder blocks are first cleaned, either in tumbling barrels or by sandblast machines. Due to their shape, it is not practicable to tumble some types of blocks in which case they are sandblasted. At the Allyne-Ryan plant, considerable ingenuity has been exercised in packing cylinder blocks for tumbling. The parts are separated in the barrels by specially designed filler cast iron pieces so that the stars used for cleaning have an opportunity to reach interior surfaces. Cylinder blocks are ground as shown in Fig. 1 on swing frame grinders equipped with carborundum wheels, 24 inches in diameter, 2-inch face, 14 grit, G plus grade. These wheels are operated at a normal speed of 5000 feet per minute peripheral travel. The blocks are ground on the top, bottom and sides and in some instances fins are knocked off with hand hammers before grinding. The object of this procedure is to remove sharp projections that wear the grinding wheels unduly.

Another important operation on cylinder blocks consists of removing core wires. Ordinarily, when considering intricate castings of various designs, the removal of the wires occupies considerable time. With standardized production, however, where the operators handle the same class of work day after day, they know just where to locate each wire and the number to remove from each block. The wires are gripped with hand hooks and are pulled through the core openings.

Testing under hydraulic pressure also is essential. The blocks are tested with water, Fig. 2, under a pressure of approximately 80 pounds to

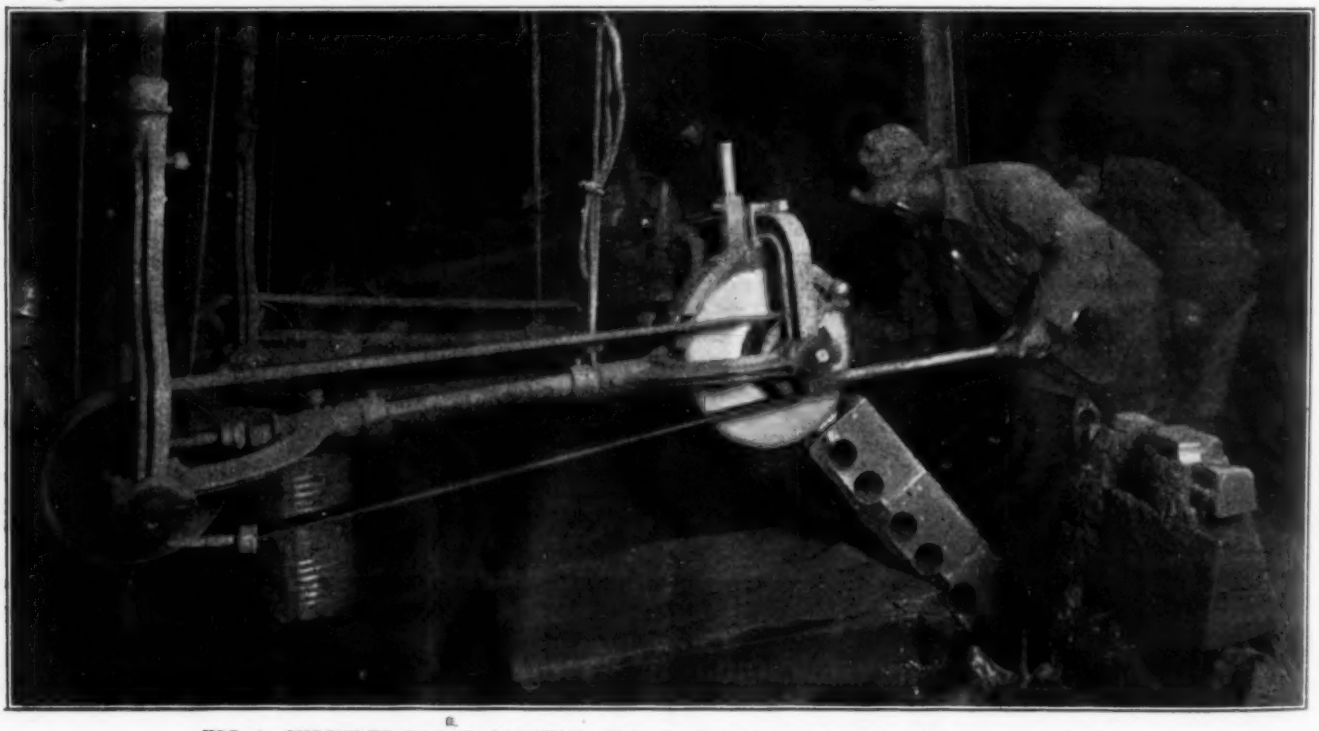


FIG. 1—CYLINDER BLOCK CASTINGS ARE GROUND UNDER SWING-FRAME GRINDERS

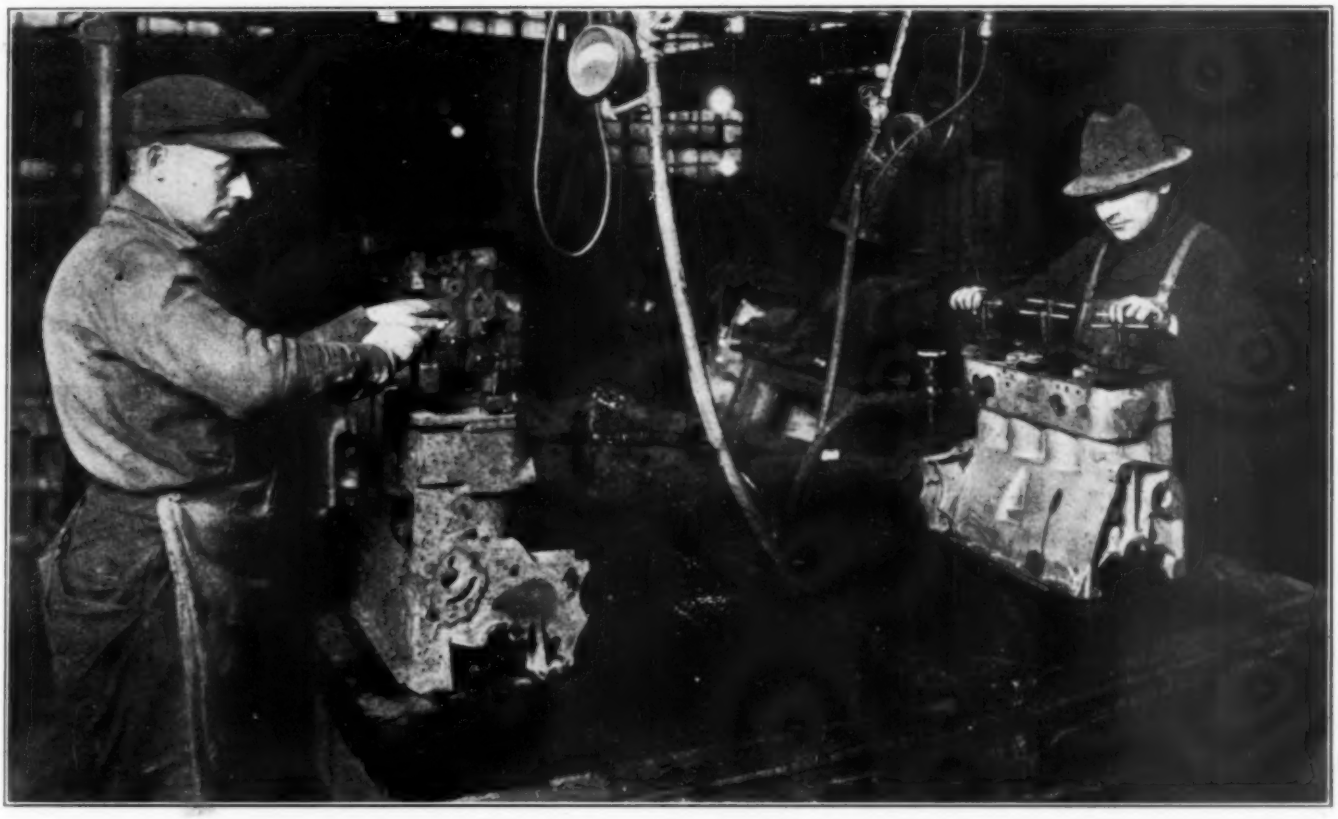


FIG. 2—ALL CYLINDER BLOCKS ARE SUBJECTED TO A WATER PRESSURE TEST

the square inch. The water is forced from underground tanks by air pressure. In this operation all the holes in the block except one are fitted with expanding rubber plugs while a similar device is attached to the water lead. After a through inspection the block castings are ready for shipment. They usually are packed in box cars, each casting being held in place by substantially nailed wood braces. While this kind of packing involves considerable extra expense, it greatly reduces breakage in transit.

Comparatively light castings, such as cylinder heads, pistons, manifolds, etc., are ground in another department to which they are delivered in

FIG. 3—SMALL CASTINGS ARE TESTED AND SORTED AFTER GRINDING

steel drums. Head and manifold castings are ground on floor grinders equipped with carborundum wheels, 20 inches in diameter, 2-inch face, 14 grit, G plus grade. These wheels are operated at 5000 feet per minute peripheral speed.

Head and manifold castings are ground in lots ranging from 25 to several hundred each and as one group of men handle one type of castings, classification after grinding is not necessary. For grinding miscellaneous castings, however, the company employs a simple system that saves considerable time. One battery of floor grinders, for example, embodies eight machines, four set back to back, with a belt conveyor between them. As the castings are ground they are thrown on this conveyor which dumps them into a bin, as shown in Fig. 3. Here they are sorted by an operator who throws them into one of several compartments on a bench. An inspector stands before each compartment. He examines each casting carefully but rapidly and throws it into a steel drum. This inspection includes gaging in many cases. For example, every piston casting must pass a careful test. Otherwise it would be rejected after shipment. The drums of inspected castings are placed on a roller conveyor which delivers them to the lower floor where they are weighed, counted and packed for shipment.

Portable grinders also are employed for performing various operations that cannot be accomplished readily on floor grinders or under swing frame machines. Ingersoll-Rand pneumatic grinders equipped with carborundum wheels 6 inches in diameter, 1 or ¾-inch face, 24 grit, G plus grade, form part of the grinding room equipment. They are used principally for removing irregularities from cylinder block castings that cannot be reached by other means. Such an operation is shown in Fig. 4.

Manifold castings must pass a careful hydraulic test before they are accepted for shipment. They are tested on the appliance shown in Fig. 5 which was devised by the company's plant engineer and consists of a quick-acting clamp type fixture for holding the work against rubber pads that block all but one hole. An expanding connection is inserted in the last hole, while the pressure is supplied by a hand pump manipulated by the operator. These castings must withstand a pressure of 80 pounds to the square inch without showing any signs of leaking.

The Allyne-Ryan company's cleaning room practice is the result of considerable experience and many tests to eliminate as much back-tracking as possible, and it proves that rough as well as precision grinding operations must be routed through the shop carefully to reduce handling costs to a minimum.

FIG. 4—PORTABLE GRINDERS ARE USED FOR FINISHING SURFACES THAT CANNOT BE REACHED UNDER SWING-FRAME MACHINES

FIG. 5—A SPECIAL APPLIANCE IS USED FOR TESTING MANIFOLD CASTINGS TO MAKE SURE THAT THEY ARE WATERTIGHT

J. L. Edwards, who has represented the F. J. Ryan & Co., in the Pittsburgh territory is no longer in charge of that territory and all business in regard to the Pittsburgh territory will be conducted for the time being from the Philadelphia office of the company.

Receiver for the Bemiller Foundry & Machine Co., Belleville, O., has been named in the person of Arliss F. Porter of Mansfield. Company directors asked for the receivership.

Harry Elvin Diller

HARRY ELVIN DILLER, metallurgical editor, THE FOUNDRY, and notable figure in the technical field of the iron and steel industry for the past twenty years, died at his home in Lakewood, a suburb of Cleveland, Thursday, Jan. 17. Although comparatively a young man, the depth and thoroughness of his scientific study, the persistence and vision which governed his research and the broad generosity which led him to share his knowledge with others, have left the impress of his personality upon American casting and metallurgical progress. His attainments may be measured in the results of his research in electric furnace practice, in the metallurgy of gray iron, malleable and steel, in technical committee activities and his numerous writings on foundry subjects, and in the hundreds of instances where he served companies and individuals, helping them by personal advice to overcome practical problems and to improve the quality of their products. But the highest tribute to his life and work is written in the remembrance of his friends and associates. Honest, kindly, earnest and considerate describe the man, although the terms are too limited to express the measure of his character. Mr. Diller was born in Lancaster, Pa., March 4, 1878. His parents died while he was young, but he was taken by an uncle and aunt, through whose interest he was enabled to attend Pennsylvania State college, to study chemistry. He was obliged to leave school before he was graduated, but later his university recognized his accomplishments in metallurgical lines and awarded him the honorary degree of master of science in June, 1912. His first employment in his chosen profession was in 1897 when he entered the laboratory of the Carnegie Steel Co., Homestead, Pa. Two years later he was placed in charge of the chemical laboratory of the Orient Steel Co., Allegheny, Pa. In 1900, Mr. Diller was employed as chemist for the Pennsylvania Malleable Co., McKees Rocks, Pa., by Dr. Richard Moldenke, who at that time was superintendent of the plant. One year later he was invited to take charge of the joint laboratory at Dunkirk, N. Y., established by the Brooks Locomotive Works, now the American Locomotive Co., and the United States Radiator Corp. of that city.

Mr. Diller occupied this position only a few months, when through the interest of Thomas D. West, then a dominating figure in the foundry world, he was made chief chemist for the Western Electric Co., Chicago in 1901. He held this position for eight years, having active charge of the testing and research work of the entire organization. His attainments secured his transfer to the research laboratory of the General Electric Co., Schenectady, N. Y., where he was associated with Dr. Whitney. For the following period until 1912 he worked on the development of the electric furnace, studied and experimented with carbon and high speed tool steel castings, investigated ferrosilicon and other products which could be made in electric furnaces.

During 1912, Mr. Diller was sent to Europe for a considerable period to investigate gray iron, malleable and steel castings practices in England, France and Germany. During this period he rounded out his knowledge and brought to bear those qualities of study and analysis which characterized his later work. Upon his return he was transferred to the Erie, Pa., works of the General Electric Co. and was placed in charge of the physical testing laboratories. As head of this department he was in touch with the company's gray iron and malleable foundries which constitute the major divisions of that plant. He also supervised the heat treating of steel at these works. He made many valuable discoveries relating to the manufacture of malleable castings and was the first to suggest the application of the tunnel kiln type of continuous oven to annealing malleable. In 1919, Mr. Diller joined the staff of THE FOUNDRY, Cleveland. As metallurgical editor he gave to the industry the results of his years of study and experience. His writings largely were of an instructive

(*Concluded, Page* 121)

Paints Stove Polish on Mold

Confronted by an Emergency Due To a Time Clause in the Contract a Chance Was Taken with Gratifying Results on a Material Not Usually Associated with a Foundry

BY ROBERT E. MASTERS

IN AN article by George Boys in a back number of THE FOUNDRY he states: "Molders will remember the secrecy surrounding the preparation of blacking used on molds. These old timers gradually died out and their mysterious mixtures died with them." From the vantage point of 75 years I may lay claim to some slight acquaintanceship with the men, the foundry habits and customs of those ancient days. I had many experiences similar to those described by Mr. Boys at various times and certainly enjoyed reading his descriptions at this late date. Probably I had my most peculiar experience with blacking in a shop in the South where I made an ammonia cylinder for an ice machine.

This cylinder 3 feet inside diameter, 12 feet long, closed dome shape at one end and flanged at the other end, was ordered in the shop where I had charge in 1883. The mold was swept on end in loam in the usual manner and blacked with material supplied by a prominent foundry supply house which claimed there was nothing superior on the market. The core was suspended from the cope and the iron was poured through a number of small gates fed from a pouring basin on the cope. The iron dropped straight down from the top to the bottom.

The casting was intended for the first ice machine ever made in the South and the president of the company, who had been an exceedingly competent loam molder in his earlier days, was greatly interested in the progress of the work and the subsequent appearance of the casting. He was present the following day when we lifted the casting out of the pit and professed great disappointment when he noted the color of the skin. The casting was solid, smooth and perfectly clean but it outshone Joseph's famous coat in its variagated color scheme. It presented patches of black, blue, yellow and gray and in some places an area of a dirty mud color. At another time the repulsive discoloration would not have been taken into account. It did not affect the utility of the casting and besides the outside surface was covered with a coat of black paint before the machine was shipped. In this instance the old president was so disappointed and angry because the casting did not present the beautiful blue color he had expected, that he forbade the use of the casting in the first machine. It was assembled eventually in another installation.

He insisted that we make a second casting, one with a presentable skin. The fact that we faced a time penalty of $25 a day if the machine was not set up and in operation in Fort Worth, Tex., on a certain date, did not weigh with him. We were located so far away from any foundry supply house that we had no chance of getting any blacking in time. He waved every objection to one side. It was the first ice machine built in the South, the first one to be erected in the state of Texas and he was determined that it should be perfect in every particular, including the color on the skin of the castings.

Secret Mixtures Offered

At this point apparently we were in a hole and the outlook was discouraging. Practically every molder in the shop approached me at one time or another during the following day and intimated that he had the formula for a blacking that would produce a perfect skin on the casting. They were in the class referred to by Mr. Boys. Each one claimed to have knowledge of a mysterious mixture, but none was willing to tell me the secret. A fair degree of familiarity with a long line of unreliable suggestions led me to distrust all these more or less disinterested offers. I felt at that time, and I have seen no reason since to change my opinion, that any plan worthy of consideration should be offered freely and openly in an emergency similar to the one with which we were confronted at that time. I am referring now to conditions that obtained 40 years ago in a locality far removed from the source of foundry supplies. I decided to depend on my own initiative.

I was somewhat familiar with the composition of a stove blacking widely advertised at that time and decided to give it a trial. I knew it could not be worse than the material we had on hand and I felt reasonably confident that it would be better. I went down to a hardware store and asked the proprietor if he kept stove polish. He admitted profanely and sadly that he did nothing else but keep it. Basing his opinion on sales, he claimed that not a single stove had been polished in that section of the country within the memory of living man. To prove his statement he showed me his first shipment of stove polish still in the original package. I bought one case and took an option—a precaution at which the dealer laughed—on the remainder of the stock.

We ground the material to a powder and rubbed it dry on the face of the second mold. We then mixed some in the form of liquid blacking and painted the face of the mold in the usual manner. Time was such an important factor in this contract that I treated a large cast iron ammonia tank mold in the same manner before I had an opportunity of observing whether or not the stove polish was serviceable. Both castings presented an ideal appearance from a foundryman's viewpoint. The old president examined them critically and then approached me with a pleased grin illuminating his foxy features. "How," said he, "did you ever come to think of employing stove polish on a loam mold?"

I told him that this faculty of thinking of things was the principal asset on which I based a claim for a salary.

Subsequently we made many of these cylinders, but adopted a different method by which we cut the time down by two-thirds. We made a set of loam casings in different diameters and lengths and in that manner could build up a mold for a cylinder of any size.

Cylinders and tanks were tested with ammonia to 300 pounds pressure and I found that this test was much more severe than where the castings were tested under ordinary water pressure. The castings were not machine finished on the inside and I took advantage of this by holding the castings in the foundry for a few days before shipping them to the machine shop. Each morning and night I had them swabbed on the interior with a good strong solution of salt and water and none leaked under subsequent pressure test.

Not the least interesting experience in connection with the first ice machine occurred after it was set up in Fort Worth one day before the contract period expired. We suspended a big bouquet in the first tank of water treated and presented the block of ice to Lydia Thompson, a famous burlesque queen of those days who was appearing that night in a local theater in *A Field of Ice*.

Rules for Calculating Speeds of Wheels

Question—How do you calculate the diameter and speed of fan driving pulleys and the amount of air necessary for a cupola. Please give the methods in detail.

Answer—The best and most practical method is to leave details of that character to the fan manufacturer. Tell him the diameter of your cupola and he will specify the fan, the diameter of the different pulleys and horsepower of the motor required to drive the outfit. However, if you simply want to know as a matter of information it may be stated that both calculations hinge on the diameter of the cupola. It has been found by experiment that a cupola melts from 8 to 12 pounds of iron per hour for every square inch of horizontal area at the melting zone. The smaller figure applies to small cupolas and the larger figure to cupolas over 4 feet in diameter. It also is accepted as a fact that 30,000 cubic feet of air are required per hour for every ton of iron melted. From this it readily will be seen that to find the volume of air required for any size cupola it is only necessary to multiply the anticipated tonnage by 30,000. The answer will be the number of cubic feet required per hour. This figure, divided by 60, will be the number of cubic feet required per minute which usually is the basis on which the output of a fan is calculated. At each revolution the fan displaces a volume of air equivalent to the space inside the casing. The space is figured by squaring the diameter of the casing, in inches, multiplying the result by 0.7854, and multiplying that in turn by the distance in inches between the two sides of the casing and then dividing the final result by 1728 to reduce the answer to cubic feet. The size of the opening in the center is calculated in the same manner and subtracted from the foregoing. Using the amount of air displaced at one revolution for a divisor and the total amount of air required per minute for a dividend, the quotient will be the number of revolutions required per minute.

The following rules are employed for figuring pulley speeds under varying conditions.

To find the speed in revolutions per minute of a fan in a simple drive where the speed and diameter of the driving pulley are known: Multiply the diameter of the driving pulley by the speed of the driving shaft and divide the product by the diameter of the pulley on the fan. Example: With the driving shaft running at 250 revolutions per minute, driving pulley 28 inches; and fan pulley 4 inches diameter; the speed of the fan spindle equals

$$\frac{250 \times 28}{4}$$

or 1750 revolutions per minute.

To find speed of a fan in a compound drive where countershaft first is driven from the main shaft: Divide the product of diameter of driving pulleys and speed of first driving pulley by product of diameters of driven pulleys. Example: The line shaft is running at 175 revolutions per minute; line shaft pulley is 16 inches diameter; driving pulley on countershaft is 18 inches diameter, while the driven pulley on counter shaft is 8 inches diameter, and fan pulley is 6 inches diameter. Then the speed of fan spindle equals

$$\frac{175 \times 16 \times 18}{8 \times 6}$$

or 1050 revolutions per minute.

To find diameter of a pulley for line shaft in a simple drive, diameter and speed of pulley on fan, together with speed of line shaft being known: Multiply the diameter of the driven pulley by its speed in revolutions per minute and divide the product by the revolutions per minute of the line shaft. Example: The pulley on fan spindle is 4 inches diameter, speed of fan spindle 1750 revolutions per minute, speed of driving shaft 250 revolutions per minute. Then the diameter of driving pulley equals

$$\frac{1750 \times 4}{250}$$

or 28 inches. In case of a compound drive the diameter of pulley on countershaft and line shaft can be worked out by application of the foregoing rule, first to the line shaft and then to the counter shaft. To find the diameter of a fan pulley required to give a certain number of revolutions per minute to the fan spindle where the diameter and speed of the driving pulley are known: Multiply the diameter of the driving pulley by its speed in revolutions per minute and divide the product by the speed desired for the fan spindle. Example: The driving pulley is 28 inches diameter; speed of driving pulley 250 revolutions per minute; speed of fan spindle is 1750 revolutions per minute. Then the diameter of fan pulley equals

$$\frac{28 \times 250}{750}$$

or 4 inches.

R. E. Ludwick, formerly sales manager for the Cleveland Crane & Engineering Co., Wickliffe, O., has joined the sales staff of Whiting Corp., Harvey, Ill. Mr. Ludwick has had many years' experience in selling cranes and is well qualified for his new position. Mr. Ludwick will make his headquarters at the Chicago sales office, 945 Monadnock block, Chicago.

Gas for Use in Foundry Ovens

Data Obtained from a Number of Runs of Cores Indicate a Close Relationship Between Cubic Feet of Gas Used and Pounds of Cores Baked in the Oven

ACCORDING to an article by F. J. Evans published in the Dec. 1923 number of *Industrial Gas* ventilation is a vital factor in core oven operation and serves two distinct purposes: It furnishes oxygen and removes fumes and moisture. The Surface Combustion Co., New York, has developed special equipment for burning gas in core oven installations and claims that it completely utilizes all the heat energy, conditions the atmosphere and maintains a rapid circulation.

The special equipment referred to was designed to burn the gas with the proper amount of air for complete combustion, gas-air proportions being maintained constant automatically. The issuing products of combustion entrain as they enter the oven, either fresh air, oven atmosphere, or any desired combination of the two. By this means the gas is burned at its greatest efficiency, the dilution taking place only after the combustion has been completed. Products of combustion issue from a special type of burner at a high velocity, and this energy is utilized to entrain the quantity of air required to maintain the desired oven atmosphere, at the same time transforming the small quantity of high temperature products to a larger quantity of comparatively low temperature drying gases.

The direct application of this principle depends upon the type of oven. Each compartment is heated by a single burner of special design lined with refractory capable of withstanding the hightest temperatures, the burner being supplied by an automatic inspirator which is designed so that gas under pressure up to 10 pounds per square inch is utilized to draw in from the atmosphere the proper quantity of air for complete combustion, forming a single pipe system, no air under pressure being required. The proportions of air and gas remain constant through all rates of burning, and the rate of burning is controlled through a single valve.

The figures in the accompanying table were taken from typical runs in an oven formerly fired with coke, but converted to a gas burning unit before the tests were taken. The oven was constructed of red brick and measured 9 x 25 x 6 feet. Large cores were loaded on three steel cars 8 x 5½ feet. The data was obtained for publication through the active co-operation and courtesies of M. B. Webber, assistant manager of the Gardner Gas Fuel & Light Co., and officials of the Gardner General Foundry, Gardner, Mass.

Gas Fired Coke Oven—General Data

Run No.	Temperature From, Deg.	Temperature To, Deg.	Hours	Deg. Rise Per Hr.	Gas Rate Coming to Temp., Average Cu. Ft. Per Hr.	Hours Held at Temp.
1	260	500	3	80	1,543	2
2	100	550	5½	82	2,040	5
3	100	450	2	100	2,040	3.5

Run No.	Gas Rate Holding at Temp., Average Cu. Ft. Per Hr.	Total Amount Cores Baked Lb.	Total Gas Used Cu. Ft.	Cu. Ft. of Gas Per Lb. of Cores Baked	Approx. Rate of Change of Air
1	1,084	5,150	6,800	1.32	20
2	657	11,256	14,500	1.29	21.6
3	980	7,200	7,500	1.04	19

Details of Run No. 3

Gas Pressure Lb.	Time P. M.	Temperature, Deg. Fahr. Rear	Center	Front
12	2:30	100	...	...
11	3:00	320	...	330
	3:30	380	...	380
11.15	4:00	...	440	415
	4:30	450	...	450
	5:00	420	...	430
	5:30	...	430	430
2½	6:00	...	450	445
	6:45	...	...	455
	7:00	...	...	460
	7:30	445	...	470
Shut down	8:00	445	480	480

Load: 9 large cores, 3 per truck, 3 small cores on floor near door.
Weight of cores: 800 pounds each.
Total weight: 7200 pounds.
Total gas used: 3990 measured at 13 pounds.
Corrected to 3 in. of H_2O: $3990 \times (14.7 + 13) \div (14.7 + 0.1) = 7500$ cubic feet.
Gas per pound of cores baked: $7500 \div 1350 = 5.55$ cubic feet.
With gas at $1.25 per 1000 cubic feet, cost per 100 pounds of cores baked: $7500 \times \$1.25 \div 7200 = \$0.13$.

Data obtained from a number of runs with charges weighing from 6800 to 14,500 pounds of cores reveal a close relationship between cubic feet of gas used and pounds of cores baked, 1.04 of 550 B.t.u. gas per pound of cores being a representative figure. This would tend to indicate that with a substantial red brick construction the heat losses of the oven are small compared to the heat absorbed by work treated. This in turn means that the heating equipment is far more important than the oven construction.

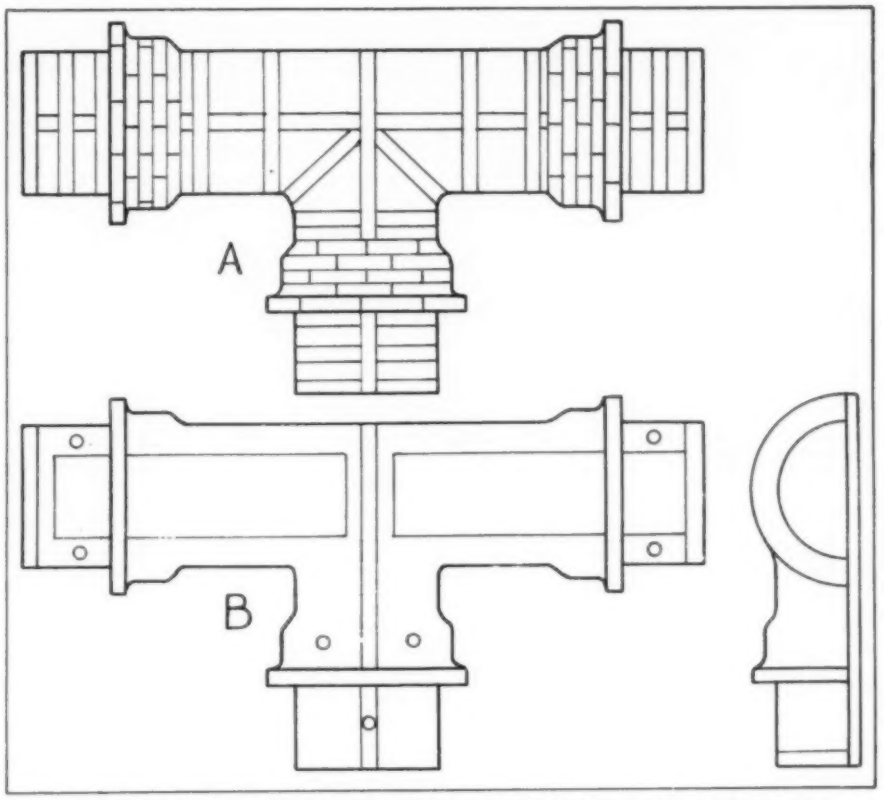
The data clearly shows that the time of bake, the fuel consumption, and weight of material are directly dependent on one another. An increase or decrease in the length of bake is due to an increase or decrease in the weight of material or heat and a like increase or decrease in fuel economy follows. Ability to produce absolute uniform conditions and duplicate them from day to day is illustrated by the excellent charts obtained on the recording thermometer used.

A charge in this oven consisted of the most extreme variation in the size of cores which ranged from a few cubic inches in volume to cores of several thousand pounds each; however, this uneven load was so uniformly heated that the oven produced daily practically 100 per cent baked cores.

Adapts Skeleton Pattern

By William Pink

Under ordinary circumstances a skeleton pattern represents the most economical form in which a pattern can be prepared and where a pattern is made up of symmetrical halves this economical



THE FRAME *B* SIMPLY SERVES AS A SUPPORT FOR PATTERN *A*

feature may be carried one step further as shown in the accompanying illustration. One half pattern conforms to the outline contour of the required casting all over. The second half is in the form of a simple frame designed to hold the first half in the correct position while the cope of the mold is being rammed.

The half pattern shown at *A* is placed on a board where it is rammed in a drag and rolled over in the usual manner. It then is drawn out of the sand and replaced by the frame shown at *B*. This frame is provided with dowel pins which locate the pattern half in position to ram the cope half of the mold. This type of construction is applicable to special patterns where only one or at most a few castings are required.

Invent Method for Metal Coating Patterns

Process for covering nonmetallic patterns with a thin coating of metal with the object of making them more durable forms the base of a patent claim put forward by H. W. Kelly, 5434 South Sawyer avenue, Chicago. The invention relates to the electroplating of wood, wax, paper, plaster, or in fact any of the easily worked materials employed for patterns. One of the principal advantages of the process is that the original pattern may be coated with copper, nickel, brass or aluminum to any desired thickness or strength and the weight will be increased only slightly. It is claimed that a pattern treated in this manner is nearly as strong as a metal pattern and in addition it also is rendered fire and damp proof by the metal surface.

The process is designed particularly to meet the needs of foundries where metal patterns are employed. It is claimed that the metal coated pattern is just as serviceable as an all metal pattern and, therefore, the only pattern expense incurred will be in the preparation of the original pattern. In other words the master pattern can be placed in production as a working pattern.

Fragile wood patterns may be covered with a protective metal coating that will help to preserve them and retain their shape while in storage; while in transit from the foundry to the pattern shop or from one foundry to another.

The process of preparing the pattern is simple. It is covered with a graphite mixture and then suspended in a plating bath until a suitable thickness of metal has been deposited. It is claimed that if necessary the metal thickness may be regulated to 0.001 inch. Patterns treated in this manner may be soldered, brazed or manipulated the same as any metal pattern, using due discretion with regard to the thin coating of metal available.

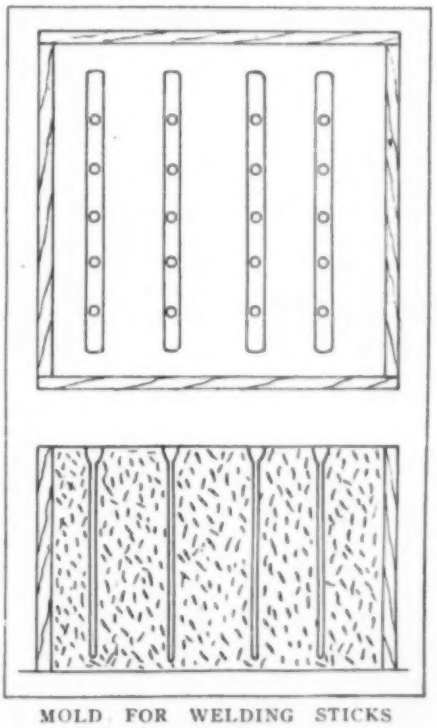
Cast Iron Welded with Special Rods

By John H. Eastham

Due either to the character of the rod or the flux employed, the welded repair area of a gray iron casting usually is too hard to machine except by grinding. If the following formula and directions are followed no trouble will be experienced in finishing a repaired area on a machine tool as usual.

Special welding rods are molded in the manner shown in the accompanying illustration. A deep drag is rammed full of sand, struck off level and then a number of V-shaped channels are cut across the face after which a ¼-inch vent wire is pushed down into the sand to any desired depth. The iron to pour these rods is taken from a charge where the analysis corresponds closely to that of the casting to be repaired. The rods are poured from a hand ladle in which about two teaspoonfuls of powdered 90 per cent ferrosilicon has been placed in the bottom before it is filled with iron. The rods easily may be broken from the runner after they have cooled.

A satisfactory flux to use in connection with these rods is made from equal parts of washing soda and cooking soda also known as carbonate of soda and bi-carbonate of soda respectively. After the repair has been effected it is advisable, where time permits, to cover the area for several hours with asbestos or other nonconducting material. This treatment will produce an annealing effect and render the metal more readily machinable.



MOLD FOR WELDING STICKS

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Contents

	Page
Making Transformer Castings	81
Organizes New Firm	85
Points Need for Sand Test	86
Reservoir Takes Place of Mixing Ladle	87
Changes Connection in Refractory Lines	87
Making Locomotive Castings—II	89
Makes Wood Lined Steel Flasks	95
Explains the Use of Magnesium	96
Can Keep Malleable from Becoming Brittle	99
War Department to Finish Liquidation	99
How and Why in Brass Founding	100
Deoxidizers for Use in Nickel Silver	100
Mixing and Casting Nickel Silver	103
Brass Pressure Casting	100
Aluminum Solder Formulas	100
Phosphor Bronze for Roll Neck Bearings	103
High Conductivity in Copper Castings	101
Troubles Are Avoided by Proper Gating	101
Bill Sets Bolt Cores in Flanged Pipe	102
Notes Effect of Uranium on Cast Iron	103
Announce Changes	106
Melts Electric Furnace Iron	107
Cleaning Automobile Castings	110
Harry Elvin Diller	113
Paints Stove Polish on Mold	114
Rules for Calculating Speeds of Wheels	115
Gas for Use in Foundry Ovens	116
Adapts Skeleton Pattern	116
Invent Method for Metal Coating Patterns	117
Cast Iron Welded with Special Rods	117
Getting More Data on Testing	118
Trade Outlook in the Foundry Industry	119
Comings and Goings of Foundrymen	120
Indiana Foundrymen in Purdue Meeting	121
New England Foundrymen Elect Officers	121
Tells of Europe's Needs	121
Philadelphia Foundrymen Choose Officers	121
Firm Tone Marks Early Sales	122
What the Foundries Are Doing	123
New Trade Publications	124

Getting More Data on Tests

MUCH encouragement may be taken from the action of the gray iron committee of the American Foundrymen's association at the meeting held recently in Detroit, in deciding to make comprehensive tests to determine the exact facts regarding the effect of different sizes of test bar and different methods of testing gray iron. At present the British, the French and the American foundrymen disagree as to the size of the test bar and even as to the methods of testing. The French claim that a test of a bar is not truly representative of the casting and this view is endorsed by foundrymen of other nationalities. The latter acknowledge that the test bar represents only the metal in the casting and this is all that can be expected from the test.

Disagreement between the British and the American foundrymen arises through differences as to size and number of test bars. So far the Americans have been satisfied with one size for a standard bar. One reason for this is that the standard bar is used only for castings of medium weight, as a rule. Thin-section castings, the metal for which would chill if cast into the standard bar, usually are not subjected to specifications requiring test bars, and when such specifications are made in rare individual cases, a special bar is provided. The same reason has kept the American foundrymen from experimenting with a larger bar for heavy castings. Furthermore, a defect in the present standard American test bar seems to be that it is not long enough to register with sufficient degree of refinement the amount of deflection of the bar under transverse test.

The committee at its initial meeting in Detroit, instead of maintaining that the size of bar already adopted by the Foundrymen's association and the American Society for Testing Materials is the best size for the purpose, has determined to make extensive tests to determine the exact relationship between tests from bars of different diameters, assuming the bar 18 inches between supports to be the correct length, thus experimenting with a bar 50 per cent longer than the present standard bar. Foundrymen are asked to make sets of bars, test some of them and send others to the committee for supplementary tests. The diameter of the bars to be tested range from 1.2 to 1.5 inches. From the results of these tests it will be determined whether the present 1.20-inch diameter bar is the best in case a single bar is to be adopted. Tests also will be made on series of bars according to the dimensions of the British standard bars. These results will throw more light on a subject of which there is comparatively little definite knowledge in America. Again, the results to be obtained from the Fremont-Portevin machine which takes small cylindrical test pieces from the casting itself are not familiar to the American foundryman and metallurgist. The latter have formed conclusions regarding the value of such tests from experience in other lines; but have no specific data in regard to the test, itself. A machine has been ordered by the committee which will make extensive tests, then, with definite data on the Fremont-Portevin test and the three sizes of test bar as advanced by the British, the committee of the American Foundrymen's association should be able to determine whether its ideas of the size of test bar and methods of testing should be modified. It also will have facts to which to point in advancing its conclusions.

Trade Outlook in the Foundry Industry

WHILE sweeping business forecasts may not be made from the first few weeks of the new year, considerable value attaches to the attitude of manufacturers entering a new period of industrial history. Calm confidence rules in the foundry industry. While operations are not such as would warrant a statement that business is good, sufficient orders are on hand to sustain a feeling of optimism. Further, specifications against first quarter contracts for coke and iron indicate an increasing melt. One shipper of coke notes that several of its larger foundry interests have called for more coke during January than during the entire last quarter of 1923.

Malleables Active

Malleable iron foundries throughout the country are experiencing an increase in business. The sole exception is among makers of railway specialty castings, who note a decrease. Agricultural castings plants are busy. Building hardware and automotive malleables are in demand. December showed increase of about 4 per cent in malleable foundry operations. Steel foundry business is better than at any time for many months, particularly among makers of small castings. The total bookings of steel foundries in December, according to the department of commerce registered 42.4 per cent of the capacity of the plants reporting, which is an increase of 2.4 per cent over November. Orders for railway steel castings increased from 33.7 per cent of capacity in November to 39.6 per cent in the last month of the year. The total bookings for 1923 amounted to 74.6 per cent of the capacity of the plants submitting reports to the department.

Prices of Raw Materials for Foundry Use

CORRECTED TO JANUARY 24

Iron		Scrap	
No. 2 Foundry, Valley	$22.50 to 23.00	Heavy melting steel, Valley	$21.50 to 22.00
No. 2 Southern, Birmingham	22.00 to 22.50	Heavy melting steel, Pitts.	22.50 to 23.00
No. 2 Southern, Chicago	24.00 to 24.50	Heavy melting steel, Chicago	18.50 to 19.00
No. 2 Foundry, Philadelphia	23.76	Stove plate, Chicago	20.50 to 21.00
No. 2 Foundry, Buffalo	22.00 to 23.00	No. 1 cast, Chicago	21.00 to 22.00
Basic, Valley	22.00	No. 1 cast, Philadelphia	20.00 to 21.00
Basic, Buffalo	23.00	No. 1 cast, Birmingham	19.50 to 20.00
Malleable, Chicago	24.00 to 24.50	No. 1 cast, Buffalo	20.00 to 20.50
Malleable, Buffalo	23.00 to 23.50	Car wheels, iron, Pittsburgh	21.00 to 21.50
Coke		Car wheels, iron, Chicago	21.50 to 22.00
Connellsville foundry, coke	$4.75 to 6.00	Railroad malleable, Chicago	21.50 to 22.00
Wise county foundry, coke	5.75 to 6.50	Agricultural mal., Chicago	20.50 to 21.00
		Malleable, Buffalo	20.50 to 21.00

Prospects Bright

The building construction outlook is one of the brightest points of promise in the industrial horizon. Even during 1921, necessity forced the continuation of building in practically all lines. New high records were made in 1922, which were eclipsed in 1923. The present winter has been exceptional in the point of the number and variety of structures which have been inaugurated. The volume of projected building for the spring is such as to promise a heavy requirement for the multitude of castings the demand for which has its origin in building construction. Unless cost considerations interfere, building in all lines will go ahead as the year advances. Orders for cast-iron pipe, one of the fundamental indicators which shows the building trends are increasing. Sanitary, heating and plumbing foundries are busy and reports indicate that jobbers' supplies have been held at a low level during the past year. Structural steel demand has been exceptionally good for the season and roll foundries have increased their operations. Purchases of iron by roll shops indicate a faith in the continued increase of demand, and except for the limiting factor of scanty labor in some instances, capacity operations govern.

Increased Output

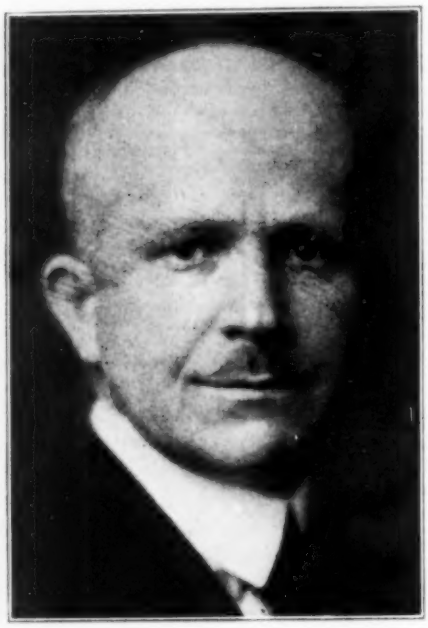
The past year witnessed an increase in the number of railway cars and locomotives manufactured, but a decrease in the number ordered. The number of locomotives ordered from builders totaled 1984 in 1923, compared with 2600 in 1922, while the number of freight car orders placed was 94,741 last year compared with 180,154 contracted during the previous 12 months. The number of locomotives built in 1923 was 3189 against 1274 in 1922. However, unfilled orders for locomotives in December is given as 387 for both domestic and foreign roads, compared with 691 for the preceding month. The total number of freight cars constructed in 1923 was 175,748 compared with 66,747 in 1922. Freight car loadings again are increasing, the total for the week of Jan. 5 being given as 703,269, compared with 615,431 for the previous week. During the past two years, the railroads have been heavy buyers, and accordingly their 1924 requirements are problematical especially in view of the efficiency with which the exceptional demands of last fall were met. Jobbing foundry operations are improving. In the eastern section, particularly in the district surrounding New York City, 60 per cent of normal capacity operation is reported. In the middle western states, a slight decline in December has been followed by an increase in the first weeks of the year. The Ohio State Foundrymen's association reports its member foundries as operating at 57.08 per cent of capacity in December, compared with 70.29 per cent in November. The tapering off is explained by the desire of manufacturing plants to approach the end of the year with a low inventory. Stocks of materials on hand increased materially. December showed the total of pig iron and scrap on hand 93.6 per cent of the normal melt as compared with 82 per cent the previous month. Stocks received during December are given as 45 per cent, while November registered 48 per cent and December, 1922, 52 per cent.

Nonferrous Advances

Brass foundry operations are increasing in practically all lines. Demand for plumbing goods and automobile castings is increasing. The Ohio brass foundries were operating at 68.3 per cent in December, compared with 60 per cent in November. New York prices for nonferrous metals, according to the *Daily Metal Trade* of Jan. 24, follow: Casting copper, 12.50 to 12.62½c; electrolytic copper, 12.75c to 12.87½c; Straits tin, 52.00c; lead, 8.37½c; antimony, 10.50c; nickel, 32.00c; aluminum, No. 12 alloy, open market, 24.00c to 24.50c. Zinc is 6.50c, E. St. Louis, Ill.

Comings and Goings of Foundrymen

JOSEPH B. DEISHER, assistant superintendent of the T. H. Symington Co., Rochester, N. Y., and for 14 years connected with that company, has resigned his position to become field representative of the American Malleable Castings association, succeeding James A. Beckett, who died last August. Mr. Deisher, who will assume his new duties Feb. 1, will be attached to the consulting engineer's office at Albany, N. Y. Mr. Deisher was born at Daggers Springs,



JOSEPH B. DEISHER

Va., Feb. 14, 1888. Finishing public school at an early age, he went to work in the iron ore mines of the Princess Furnace Co. At the age of 18 he was graduated from the National Business college, Roanoke, Va., and became secretary to the late J. E. Johnson Jr., at that time general manager of the Princess Furnace Co., at Glen Wilton, Va., and later one of America's leading authors and authorities on blast furnace practice. In April, 1909, Mr. Deisher became secretary to W. R. Bean, who was works manager of the T. H. Symington Co., manufacturer of malleable iron railway supplies. He served four years in the various shop executive offices of this company, two years as foundry clerk, and six years as metallurgist and melting foreman and two years as assistant superintendent. He was one of the pioneers in the successful application of pulverized coal to malleable iron melting and within the last year has designed, built and operated a large reverberatory furnace.

Peter Hott, for more than 30 years foreman and superintendent of foundries, has associated himself with the Roberts Brass Co., Milwaukee, as vice president and manager of the foundry.

Alfred Vick has accepted a position with the faculty of the Hampton institute, Hampton, Va. Mr. Vick, who has had wide experience as a metal pattern maker in New England, will instruct classes in mechanical drawing, mathematics and mechanics.

R. F. Harrington, who has recently been elected vice president of the New England Foundrymen's association, is metallurgist for the Hunt Spiller Mfg. Co., South Boston. Mr. Harrington entered the employ of this company soon after his graduation from Tufts college, Mass., in 1913.

A. N. Duncan now is connected with the Patent Cereals Co., Geneva, N. Y., in the capacity of foundry service expert. He has had an extended foundry experience in iron and steel and for the past 25 years has been connected as foreman or superintendent with several prominent steel foundries in various parts of the United States and Canada.

LeRoy M. Sherwin recently has been made plant manager for the Central Foundry Co., Newark, N. J. Mr. Sherwin entered the foundry business as a helper at the plant of the Wellman-Seaver-Morgan Co., Akron, O., in 1905. Since that time he has been connected continuously with the industry in some of its phases except for four years spent at college where he completed a course in mechanical engineering. He was engaged in various capacities by different companies including the General Electric Co. For the past several years Mr. Sherwin has been mechanical engineer and later assistant foundry superintendent for the Brown & Sharpe Mfg. Co.

Norman Russell, who has just been elected president of the New England Foundrymen's association, has been a foundryman for about 17 years, having entered the employ of Albert H. Russell & Sons Co., at Newburyport, Mass., immediately after his graduation from Dartmouth college in 1906. During this time he has held positions in all departments of the company and is now its president. He is active in state and municipal affairs and heads several organizations. The Albert H. Russell & Sons Co. manufactures miscellaneous heavy machine castings, as well as bronze tablets.

Frederick M. Becket, chief metallurgist of the Electro Metallurgical Co., and vice president of the Union Carbide & Carbon Research Laboratories, Inc., was awarded the Perkin Medal of the Society of Chemical Industry, on Jan. 11, for his achievements in the

FREDERICK M. BECKET

field of applied chemistry. Mr. Becket has spent many years in working with electric furnace products, principally those ferroalloys and alloying metals which are indespensable to basic open-hearth and alloy steels. While he has been closely associated with the entire ferroalloy industry, his influence has been especially marked in his discoveries and developments in the reduction of molybdenum and vanadium with silicon metal, the perfection of low carbon ferrochromium, chromium metal, and many heat resisting alloys of iron and chromium, and more recently the perfection of manufacturing processes and the technique of using the new alloy ferrozirconium. The latter has developed attractive qualities for steel making, in that it at once counteracts the bad effects of oxygen, phosphorus and sulphur in steel. In addition to these activities, Mr. Becket has been greatly

interested in metallurgical problems connected with welding and cutting by the oxyacetylene flame, and is directing several investigations along these lines.

Harry Elvin Diller

(*Concluded from Page* 113)

nature and he answered numberless inquiries on individual foundry problems. Further, he carried along his own study and development through visiting various foundries throughout the country and in describing their practices.

Mr. Diller always was active in the affairs of the American Foundrymen's association and the American Society for Testing Materials. He served as a vice president of the former organization in 1901 and later for a number of years was a member of the board of directors. In the American Society for Testing Materials, he was an early member of committee A-3 on cast iron, and when malleable iron was deemed worthy of separate attention he was chairman of committee A-7 formed to consider specifications and tests for that metal. He was chairman of subcommittees on general castings and nomenclature and gave valued service in the matter of specifications and recommended analyses. His most recent interests have been directed toward the work of the committee on an international test bar, when his advice was sought by the American Foundrymen's association committee on this subject.

Mr. Diller is survived by his wife, Lucile Preston Diller, to whom he was married in 1904.

Indiana Foundrymen at Purdue Meeting

The second annual conference of Indiana foundrymen, representing interests from throughout the state, met in a two-day session at Purdue university, Lafayette, Ind., Jan. 17 and 18. W. A. Knapp, assistant director engineering extension service at the university, presided and in introducing Dean A. A. Potter who welcomed the delegates, he pointed to some of the features of service which the university is rendering to industry. R. E. Wendt, instructor in foundry practice, and G. F. Buxton, assistant professor of industrial education, presented two interesting viewpoints on the subject of apprentice training. Mr. Wendt depreciated the change of attitude toward foundry work. He recommended a course of instruction tending more toward foremen or foundry executive training to be offered by the university. Prof. Buxton defined the present shortage as one of semiskilled rather than skilled men. He emphasized the need for incentive and for real leadership among the foremen so that they may teach men to feel the thrill of production.

E. J. Lowry, Hickman, Williams & Co. Chicago, presented a paper on the metallurgy of gray cast iron. An interesting paper on the manufacture of steel castings prepared by William Woodhall, National Car Coupler Co., Attica, Ind., was read by a representative of the firm, in the absence of the author. G. W. Gilderman, Dodge Mfg. Co., Mishawaka, Ind., described in detail his practice in melting and pouring semisteel. He recommended placing large steel scrap directly on the bed charge of coke and in the center of the cupola away from the sides. When small steel scrap is used, he recommended that it should be added after the pig iron. An extra 5 per cent of coke was advised for melting heavy steel scrap. He called attention to the danger in high steel mixtures incident to quick setting and stated that heavy sections should be fed or chilled to prevent sponginess. Aluminum, ferrotitanium, and vanadium were recommended as fluxes for use in the ladle of semisteel.

W. D. Hammerstadt, Rockwood Mfg. Co., Indianapolis, president of the Indiana foundrymen, presided at a business session and smoker held Thursday evening, January 17. He urged the need of the foundrymen for the association work and presented his views of the activities to be followed.

J. D. Hoffman, head of the department of practical mechanics, Purdue, presided at the sessions Friday morning. Papers on electric furnace operation, by W. K. Booth, Booth Electric Furnace Co., Chicago, and on nonferrous metals by E. G. Jarvis, Niagara Falls Smelting & Refining Co., Buffalo, were read. After discussion, a motion picture depicting the use of the sand throwing type of molding machine in foundry work, was presented by the Beardsley & Piper Co., Chicago. Friday afternoon was devoted to the inspection of various shops and classes of the engineering department.

New England Society Elects Officers

Norman Russell of Newburyport, Mass., was elected president of the New England Foundrymen's association at the twenty-eighth annual meeting of the organization held Jan. 9, at the Exchange club, Boston. Nearly 200 members were in attendance at the meeting which was the occasion of more enthusiasm among foundrymen than has been expressed in a long time. It was an interesting coincidence that on the same evening the foundrymen's clubs of Newark, N. J., and Philadelphia also held their annual meetings. Telegrams expressing friendly interest and a desire to co-operate were exchanged between the three organizations during the evening. Other officers elected at Boston were: R. F. Harrington, Hunt-Spiller Mfg. Corp., South Boston, vice president; George H. Gibby, Gibby Foundry Co., East Boston, treasurer; Fred S. Stockwell, Barbour Stockwell Co., Cambridge, Mass., secretary; H. P. Blumenauer, Arcade Malleable Iron Co., Worcester, Mass.; H. S. Chaffe, Providence, R. I.; T. Officer, Clairmont, N. H.; Carl H. Newman, New Britain, Conn.; and C. A. Reed, Boston, compose the new board of directors.

Tells of Europe's Needs

Discussing intimately conditions abroad, Dr. Richard Moldenke, Watchung, N. J., unfolded the story of his recent three months' visit to England, France, Italy and Germany at a meeting of the Newark Foundrymen's association held Jan. 10. The attendance was one of the best in the history of the organization, and included many foundrymen from adjacent cities. Significance was attached to the fact that meetings were also being held the same evening by the New England and Philadelphia Foundrymen's associations in Boston and Philadelphia, respectively. Greetings exchanged between the three associations brought forth the suggestion from the Philadelphia foundrymen that a committee be appointed by each association to hold joint meetings at least annually if not oftener, to further the progress of their work.

Philadelphia Foundrymen Choose Officers

An interesting meeting of the Philadelphia Foundrymen's association was held at the Manufacturers' club in that city Jan. 9. George E. Buxton, Pottstown, discussed business trends. J. P. Mudd, Bethlehem Steel Co., presented a series of motion pictures covering plant operations of the Midvale Co., Nicetown, Philadelphia. Mr. Mudd stated that the first steel castings made in American were frogs for the Reading railway made in 1867 at the Midvale plant then known as the William Butcher Steel Works.

The officers of the Philadelphia Foundrymen's association were re-elected for the ensuing year. These include: President, Frederick M. Devlin, Philadelphia Hardware & Malleable Iron Co.; vice president, C. R. Spare, American Manganese Bronze Co.; treasurer, W. G. Summers, Phoenix Iron Co.; secretary, Howard Evans, J. W. Paxson Co.

Firm Tone Marks Early Sales

Increasing Volume of Inquiry for Foundry Equipment Is Accompanied by Growing Demand for Supplies—Idle Foundries Again Coming into Activity Require Machinery

VOLUME and quality of early 1924 foundry equipment inquiry alike presage increased business for manufacturers. Although foundry operations have not picked up to a marked degree, apparently the replacement and extension of casting plant machinery is going ahead. Supply sales are increasing more rapidly than are equipment orders. Recent sales of sand blast equipment include a unit to Peck Stow & Wilcox, Cleveland, to be installed by the Pangborn Corp., Hagerstown, Md. The Forest City Foundry Co., Cleveland has purchased a sand blast mill from the W. W. Sly Mfg. Co., Cleveland. Recent sales of tumbling mills by the latter company include the C. & G. Cooper Co., Mt. Vernon, O., A. C. Williams Co., Ravenna, O., and Mitsui & Co., Ltd., Japan, while the Ferro Machine & Foundry Co. has contracted for complete dust arrester equipment with the Sly company.

Note Change in Eastern Trend

MATERIAL improvement is noted in demand for foundry equipment in the eastern district. Replacement orders are coming out freely and include some fair-sized contracts, while at the same time, some business is being placed for new construction. A particular improvement is noted in sand cutters with a leading order involving four machines for various plants of a concern with headquarters in New York City. Other buying includes two 15-ton ladles for the American Smelting & Refining Co., New York City, to the Whiting Corp., Harvey, Ill. A substantial buyer is Florence Pipe Foundry & Machine Co., Florence, N. J., which has just closed on two 15-ton electric cranes, 60-foot span, to the Pawling & Harnischfeger Co., Milwaukee and is understood to be figuring on additional equipment. The Newark, N. J., foundry of the Crocker Wheeler Co., Ampere, N. J., recently has been purchased by Alexander Morrison and Harry Flockhart, both of Newark. It is understood the plant, which has been idle for sometime, will again be operated in the production of gray iron. The machinery installed in the plant was included in the purchase, but it is believed that some new equipment will be necessary.

The Reading Hardware Co., Reading, Pa., will erect a $50,000 power house, to serve a recently constructed foundry. The David E. Allen Yonkers Foundry, Yonkers, N. Y., has lately closed on a 6-ton overhead traveling crane to the Whiting Corp., and the Fagan Iron Works, on two 5-ton electric cranes, 23-foot span, to the Shepard Electric Crane & Hoist Co. The Union Stove Works, Peekskill, N. Y. has ordered six tumbling mills from the W. W. Sly Co., Cleveland. The American Radiator Co., Buffalo, has ordered sand blast equipment and John M. Crawford Foundry, Parkersburg, W. Va., and the Co-operative Foundry Co., Rochester, N. Y., each have contracted for sand blast and dust arrester installations with the Pangborn Corp., Hagerstown, Md.

Inquiries Improve in Pittsburgh Area

CONSIDERABLE improvement both as regards buying and inquiring is shown in certain lines of foundry equipment in the territory embraced by the Pittsburgh district. Inquiries for molding machines for instance never were more numerous, the Herman Pneumatic Machine Co., Zelienople, Pa., reporting that orders are about to be placed for individual installations and groups of machines. These, together with machines on order about to be shipped, give every indication that foundry operation will be pursued this year on a plane never before reached. The company is literally swamped with inquiries. Recent orders for this type of equipment, however, have been confined for the most part to individual items although the J. L. Mott Iron Works, Trenton, N. J., bought three. The Allied Steel Castings Co., West Harvey, Ill.; the Union Steel Casting Co., Pittsburgh; the General Fire Extinguisher Co., Atlanta, Ga.; the Raritan Foundry Co., Raritan, N. J.; the Urick Foundry Co., Erie, Pa.; the National Radiator Co., New Castle, Pa.; and the Union Switch & Signal Co., Swissvale, Pa., each bought one unit. Some interesting ladle orders recently have been taken by the Whiting Corp., Harvey, Ill., including one for three fair-sized ladles from the Butler Car Wheel Co., Butler, Pa., and two 15-ton special ladles from the American Smelting & Refining Co., New York City. Orders for one each 5300-pound capacity ladles, were received from the Bay City Electric Steel Castings Co., Bay City, Mich., and the Millbury Steel Foundry Co., Millbury, Mass., while one for two 9-ton bottom-tapped ladles came from the American Steel Foundries, Pittsburgh. The Whiting Corp. also took orders for tumbling barrels from the Buick Motor Co., Flint, Mich., and the Wheeling Steel Corp., Wheeling, W. Va. One cupola was ordered by the American Foundry & Machine Co., Hamilton, O., and another was ordered by T. P. Kelly & Co., Brooklyn, N. Y. The Chicago Bearing Metal Co., Chciago, bought miscellaneous monorail equipment from this same manufacturer. The movement of miscellaneous foundry equipment has been only fair during recent weeks. Most foundries have supplied their immediate needs in riddles, grinders, etc. The Standard Sanitary Mfg. Co.'s inquiry for its new Baltimore plant is pending, calling for machine tools, foundry equipment and cranes. Orders are expected to be placed for some of this machinery shortly. The Westinghouse Electric & Mfg. Co. is in the market for 50 or more machine tools, etc., on its first quarter list now being well circulated for its East Pittsburgh, Pa., plant and other service stations. Crane inquiries are fairly numerous in this territory and occasionally orders are placed. A foundry in Springfield, O., has just closed on a crane with a Detroit crane builder. The Northern Engineering Works of that city recently received the following orders: a 5-ton I-beam crane from the Union Steel Casting Co., Pittsburgh; a 5-ton, 3-motor electric traveling crane from the St. Louis Steel Castings Co., St. Louis; a 5-ton 38-foot span overhead crane from the Railway & Industrial Engineering Co., Greensburg, Pa., and two 5-ton 40-foot span 3-motor overhead cranes from the Sawbrook Steel Casting Co., Cincinnati.

New England Outlook Favorable

SOME improvement in foundry activity in New England has developed during the past month, but buying of equipment has not started as yet along any extensive lines. A manufacturer of sand-blast equipment reports greatly improved inquiry. The Springfield Malleable Iron Co., Springfield, Mass., is in the market for an air compressor. The Fremont Foundry, Worcester, Mass., has purchased the plant and property which it has been leasing in the past and alterations and extensions are planned. This company has bought

a jolt roll-over molding machine and is in the market for additional equipment. A new pattern shop will be built. Some crane inquiry from foundries has developed. This includes a 25-ton and a 10-ton electric crane which are expected to be ordered early in February. The Chapman Valve Mfg. Co., Indian Orchard, Mass., has contracted for sand blast and dust arrester equipment from the Pangborn Corp., Hagerstown, Md.

Inquiry Grows In Chicago District

MANUFACTURERS of foundry equipment are well satisfied with developments since the turn of the year. Sales have not boomed, but a good volume of inquiry is out—inquiry from interests apparently planning to buy, and not mere feelers. The Chicago board of education has purchased two Pridmore power squeezers from the Federal Machinery Sales Co., Chicago, and has more foundry equipment, including a cupola, yet to place. Sales of the Whiting Corp., Harvey, Ill., include a No. 2½ cupola to the W. H. Cain Gas Radiator Co., Los Angeles, a No. 3 cupola to the London & May Foundry, Salt Lake City, Utah; a No. 4 cupola to the Craig Foundry, Brooklyn, N. Y., and a charging machine to the Studebaker Corp., South Bend, Ind. The National Engineering Co., Chicago, has closed for sand mixers for the Griffin Wheel Co., Detroit; the Chicago Steel Foundry Co., Chicago; Butler Car Wheel Co., Butler, Pa., and the Otis Elevator Co., Buffalo, N. Y. This company also has placed a sand mixer in a Japanese foundry. The Chevrolet Motor Co., Flint, Mich., has ordered sand blast equipment, and the Western Malleable Castings Co., Los Angeles, Cal., a dust arrester installation from the Pangborn Corp., Hagerstown, Md. Tumbling mills recently have been sold by the W. W. Sly Mfg. Co., Cleveland to the National Sewing Machine Co., Belvidere, Ill.; Oakland Foundry Co., Belleville, Ill.; Dalton Foundry, Warsaw, Ind.; Michigan Malleable Iron Co., Detroit, and Muncie Malleable Foundry Co., Muncie, Ind. The Detroit Stove Co., Detroit, will install dust arrester equipment to be made by the Sly Company.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

Keystone Iron Works, Inc., Honesdale, Pa., operator of a gray iron foundry, damaged by fire recently, will start rebuilding shortly.

The New Haven Foundry Co., New Haven, Mich., operator of a gray iron foundry, has been leased by a company from Rochester, N. Y.

Southern Wheel Foundry, Norfolk, Va., plans $100,000 addition of brick and concrete, to be built on the west side of Lansing avenue on the Belt Line railroad. W. P. Randall is engineer.

The Wolverine Castings Co., Detroit, has begun moving its foundry from Kalamazoo to Plainfield, Mich., where a new plant has been constructed.

Shelton Bros., Paducah, Ky., operator of gray iron and brass foundries, plans 1-story foundry for manufacture of steam boat machinery, addition to cost about $40,000.

Barnhart-Davis Foundry Co., Warren, Pa., damaged by fire Jan. 1 with about $50,000 loss to foundry pattern works and machine shops, will rebuild those units. Plans are being prepared.

Landis Tool Co., Waynesboro, Pa., is submitting plans on erection of a 1-story foundry costing about $60,000 to replace the unit damaged by fire several months ago at Greencastle, Pa.

Kruecke Bros. Mfg. Co., 517 Park street, Milwaukee, manufacturer of brass castings and nonferrous metal products, has filed a voluntary petition in bankruptcy with listed liabilities of $57,617 and assets of $42,411.

American Laundry Machinery Co., Sherer street, Rochester, N. Y., plans a 1-story, 80 x 100-foot, brick and steel foundry and pattern shop. John Strobel, 622 E. & B. building, is architect and engineer.

Galion Iron Works & Mfg. Co., Galion, O., operator of gray iron, brass and aluminum foundries, plans a $50,000, 1-story, 50 x 160-foot brick foundry building. Althous & Jones Market building, Mansfield, O., are architects.

The Production Foundry Co., Columbiana, O., has been incorporated for $25,000 to carry on general foundry business by W. B. Stevenson, L. P. Kulka, W. D. Young, A. G. Davis and W. Krauss. Operations are to begin as soon as the plant recently purchased from a Youngstown company is placed in condition.

Lunkenheimer Co., Cincinnati, is taking bids through its architect for a 1-story machine shop at Carthage, O., dimensions to be 308 x 410 feet. The company operates gray iron, malleable, steel and brass foundries.

Crocker-Wheeler Co. has sold its foundry at the foot of Rome street, Newark, N. J., to an unnamed buyer. All of the equipment was included in the sale. No extensions are expected to be made at present by the new owner.

Nassau Brass Foundry, Brooklyn, N. Y., has been incorporated for $25,000 to make nonferrous castings, by W. C. and C. P. and C. L. McGrath, with J. Harris, 1545 Broadway, as attorney.

The Crane Co., 836 South Michigan avenue, Chicago, operator of various foundries, plans the construction of additional facilities at Savannah, Ga. A warehouse is contemplated for Jacksonville, Fla.

Universal Bearing Bronze Co., Winsted, Conn., operator of a brass foundry, was damaged by fire recently with loss of about $40,000 to plant and equipment. David Goldich, John O'Brien and E. B. Gaylord are owners.

Industrial Steel Casting Co., Millard avenue and Front street, Toledo, O., is building 80 x 102-foot plant for foundry use. Joseph Tillman Sr. is president and general manager. Larger additions are contemplated for spring construction.

Canadian Westinghouse Co., Hamliton, Ont., has awarded the steel contract to the Hamilton Bridge Co. for foundry to be erected on Aberdeen avenue west. Bids for other work and equipment are being received by B. H. Prack, Main street east, Hamilton.

Kohler Co., Kohler, Wis., manufacturer of bath tubs, etc., will build brick factory addition, 60 x 180 feet, and a 100 x 274-foot cleaning room. Most of the equipment necessary for the expansion has been purchased. Walter J. Kohler is president.

Stanley G. Flagg Co., Morris building, Philadelphia, operator of gray iron and malleable foundries, etc., plans rebuilding its plant at Stove, Pa., recently damaged by fire. The Ballinger Co., Twelfth and Chestnut streets, Philadelphia, is architect.

Central Pattern Co., 216 Morgan street, St. Louis, has been incorporated for $20,000 to make, manufacture and deal in wood and metal patterns, molds, castings, etc., by John H. Wedde, Louise M. Wedde, Fred W. Wack Jr. and Helen Wack.

Babe Pipe & Foundry Co., Inc., Thirty-second and Whiteside streets, Chattanooga, Tenn., will be operated by Frank Gebbie, Rochester, N. Y., and his associates following their recent purchase of controlling interests. Mr. Gebbie now is president.

Northern Machine & Mfg. Co., Seattle, has consolidated with the Harbor Brass Foundry, under the name of the former. In addition to making brass, bronze and aluminum castings, the company will continue its blacksmith shop and acetylene welding business.

General Metal Products Co., Inc., Lancaster, Pa., recently incorporated for $25,000, has placed contracts for some equipment for a plant under construction. The company will manufacture brass, bronze and aluminum castings and automobile accessories. John E. McGovern is interested.

American Sanitary Mfg. Co., Abingdon, Ill., operator of brass and aluminum foundry, has purchased the Northern Brass Mfg. Co., Waukegan, Ill., operator of brass foundry. Equipment of the latter company will be moved to Abingdon. Capitalization of the American company was increased from $250,000 to $500,000.

The Western Iron & Steel Co., Detroit, recently incorporated with a capital of $125,000 and 12,000 shares no par stock, has been formed to produce gray iron and malleable iron castings. Montgomery Whaling, 3044 West Grand boulevard, is one of the incorporators, others being C. R. Talbot and Max Kahn. The company recently purchased the property of the Vassar Castings Co., Vassar, Mich. Much of the equipment in the present plant is

being scrapped and modern machinery being installed. It is planned to erect a new plant.

Warmack-Williams Stove Co., 1601 North Sixth street, Fort Smith, Ark., will purchase some new equipment for its plant. The company was incorporated recently for $30,000 to manufacture gas stoves and ranges. George Warmack is president, George H. Williams vice president, Hill Williams secretary and treasurer, and John Warmack general manager. The same men hold identical offices in the recently incorporated Fort Smith Stove & Foundry Co., South Fort Smith, Ark. This latter company was incorporated for $30,000 to manufacture wood and coal stoves and also will conduct a general foundry business.

New Trade Publications

HOISTS—The New Jersey Foundry & Machine Co., 90 West street, New York, has published a folder illustrating trolleys, cranes and electric hoists manufactured by this company.

LADLES—The J. S. McCormick Co., Pittsburgh, have published a new catalog of a line of foundry equipment and ladles. Various types and sizes are shown as well as the necessary safety features.

SKYLIGHT CLEANER—A special report has been issued of a survey made for the Skybrite Co., Cleveland, on the use of the product of this company by the Joseph T. Ryerson & Son, Inc., in cleaning the skylight of the Jersey City, N. J., warehouse.

STOKER—The combustion Engineering Corp., Broad street, New York, has issued a folder describing and illustrating a new stoker which operated on the underfeed principle. Special features of design are discussed and representative installations listed.

WELDING—The International Oxygen Co., Newark, N. J., are distributing a small memorandum book which was compiled with the idea of furnishing the user of compressed gases with answers to questions arising in daily practice.

ELECTRIC HEATERS—"Strips of Electric Heat" is the subject of a folder issued by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., describing an electric heater designed for heating out of the way places. The heater operates on either 220 or 100 volts.

FRICTION CLUTCH—Various types of friction clutches are described and illustrated in a 56-page booklet issued by the W. A. Jones Foundry & Machine Co., Chicago. Numerous tables are included, chief among which are the tables giving list prices and specifications.

ARMORED TRUCKS—The R. G. Haskins Co., 520 West Monroe street, Chicago, is distributing a section of veneered steel from which a steel truck is made. This built-up steel and wood gives added strength, it is claimed, and also is lighter.

RUST PREVENTIVE—A chemical compound which is used to prevent the rusting of metals is described in a 32-page booklet issued by the Dearborn Chemical Co., Chicago. This compound is especially applicable to parts in iron and steel mills, machine tools, finished products of iron and steel, etc.

CUPOLA CHARGING MACHINES—The advantages to be found in employing a machine for charging a cupola are set forth in a bulletin of the Whiting Corp., Harvey, Ill. Views of various installations are shown together with a partial list of the companies already using the machine charger.

WELDING APPARATUS—Apparatus used in welding such as acetylene generators, compressing plants, welding and cutting torches, regulators, gages, etc., are described in a bulletin issued recently by the Alexander Mildurn Co., Baltimore. Another bulletin from the same company describes the many uses to which a carbide light may be put.

PORTABLE ELEVATORS—The New Jersey Foundry & Machine Co., New York, has issued a folder illustrating the uses to which their portable elevator may be put. Views show the elevator being used as a permanent elevator between floors, for handling roll stock, barrels, boxes and bales.

RUST PREVENTION—The various factors causing the lead manufactured by the Eagle-Picher Lead Co., 208 South La Salle street, Chicago, to be applicable for rust prevention are described in a 16-page booklet issued by this company. Directions for mixing and applying are included.

FLEXIBLE COUPLINGS—Smith & Serrell, Central avenue and Halsey street, Newark, N. J., recently have issued a booklet describing the design of a flexible coupling and illustrating the many uses to which it may be put. Various tables are included for use in determining the size of the coupling to be used.

PRESSES—A bulletin recently published by the Oilgear Co., Milwaukee, announces the introduction of a new line of selfcontained broaching and assembly presses built in 15, 25 and 50-ton capacities. The principal features, such as accurate control of ram speeds and pressures, are discussed and detailed specifications included.

BUCKET HANDLING CRANES—The Whiting Corp., Harvey, Ill., has issued a folder on bucket-handling cranes. Views of various installations are included showing overhead travelers, gantry cranes and stationary transfer cranes adapted to the handling of coal, cement, cinders, fertilizer, etc.

OIL BURNERS—"The Correct Method of Burning Fuel Oil" is the subject of a booklet published by the Mahr Mfg. Co., Minneapolis, Minn. Various types of atomizers, venting methods, trench-fired furnace, open chamber furnace, life of furnace lining, use of refractory materials, etc., are some of the topics discussed.

CONVEYING SYSTEMS—Conveying pulverized materials by means of compressed air is discussed in a folder published by the Fuller-Lehigh Co., Fullerton, Pa. A diagram showing the arrangement of the various parts of the conveying system as well as views of the pump, electromagnetic valve, bin indicator and a portable pump are included in the publication.

INSULATION—The Armstrong Cork & Insulation Co., Pittsburgh, recently has published a 64-page booklet entitled Insulation, 200-1500 degrees Fahr. This book covers the subject to insulation of high temperature apparatus used by practically all industries in such places as steam lines and equipment, ovens, furnaces, stills, etc.

CRANES—Many applications for locomotive cranes are described and illustrated in a booklet which has been issued by the Brown Hoisting Machinery Co., Cleveland. The applications described include coal yards, docks, foundries, general contractors, industrial plants, scrap yards, etc. Clearance diagrams of various types of cranes also are included.

STEAM HAMMERS—In a 24-page booklet published by the Morgan Engineering Co., Alliance, O., various types of steam hammers are described and illustrated. The bulletin briefly calls attention to some of the prominent features of the line of hammers manufactured by this company and shows the size and variety of hammers and equipment that can be furnished.

TIME STUDY BOARD—The Stein & Ellbogen Co., 31 North State street, Chicago, has issued a folder describing and illustrating a board used in making cost data time studies. The board is provided with a convenient writing surface for holding the record blank, holds the watch in a position such that it can be operated easily and provides a convenient space for holding all data pertaining to the work at hand.

ACID TESTERS—A quick method for testing the strength of the acid in pickling liquors is presented in a booklet entitled "A Pickling Prescription," which recently has been published by Marsh & Cochran, Youngstown, O. This method employs the use of a small capsule, the acid content being determined by the color changes that take place in the sample being tested.

TOOLS—Small tools and gages are illustrated and described in a 494-page catalog recently issued by the Pratt & Whitney Co., 111 Broadway, New York. Rather extensive information is included on taps, dies, screw plates, milling cutters, cutters for machines manufactured by this company, also reamers, punches, drills, miscellaneous tools, gages and standards. The catalog is well illustrated and contains a number of valuable tables.

STEEL JOISTS—Bar joists for building fire-safe floors are described in a pamphlet published by the Massillon Steel Joist Co., Massillon, O. These joists are built of five steel bars formed and welded to the shape of a steel truss and provided with steel bearing plates at each end. The pamphlet is illustrated with drawings showing the application of the joists and with views of actual installations. A chart showing the loading capacities also is included.

LUBRICATION—A 52-page booklet recently has been issued by the Dearborn Chemical Co., Chicago, which contains information designed to aid the purchaser of lubricating oils and greases in choosing the grades that will help toward developing maximum efficiency in the power equipment. The laboratory where the lubricants are tested is described and illustrated and the methods used in testing are included.

WELDING—"Cast Iron Welding by the Oxy-Acetylene Process" is the subject of a 122-page book recently issued by the Linde Air Products Co., New York. The subject matter deals with the nature and properties of gray cast iron, equipment necessary for welding, preparation for welding, finishing the weld, testing and estimating cast iron welding jobs. Some typical welding jobs are described and the practical problems encountered in welding are discussed. The book is well illustrated.

WELDING—A short treatise on the economy and value of welding in industry is contained in a 62-page booklet issued by the Wilson Welder & Metals Co., Inc., New York. Various topics pertaining to welding are discussed, including why arc welding is used, advantages of arc welding, new types of machines, and the importance of using correct metals. Considerable space is given to a discussion of the repair work done on German ships interned in the United States harbors during the war. The last portion of the booklet is devoted to illustrations brief specifications of the welding units manufactured by this company.